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CONTENTS

	Page
Documentary Reproduction	29
Soil Conservation in India. By Prof. H. G. Champion, C.I.E.	31
Descartes' Philosophy. By Prof. A. D. Ritchie	32
Photographic Technology. By Dr. L. E. C. Hughes	32
The Menace of Declining Population. By T. Raymont	33
Essays on Biology	33
International Genetics Conference	35
Documentary Reproduction. By Lucia Moholy	38
The Solar Eclipse of 1945 and Radio Wave Propagation. By Dr. R. L. Smith-Rose	40
Obituaries :	
Dr. J. F. Tocher. By Prof. James Ritchie	42
Mr. B. B. Bancroft. By Dr. Archie Lamont	42
News and Views	43
Letters to the Editor :	
Infra-Red Absorption Spectrum of Diamond.—Dr. R. S. Krishnan and K. G. Rananathan ; Dr. G. B. B. M. Sutherland	45
Electronic Spectra of Polyatomic Molecules. Vibrations of the $^1B_{2u}$-State of Benzene.—Prof. C. K. Ingold, F.R.S., and Francesca M. Leeke	46
Lattice Distortions and Shear in Aluminium Single Crystals.—Prof. W. G. Burgers and F. J. Lebbink	47
Solar Radiations in the 4–6 Metre Radio Wave-Length Band.—J. S. Hey ; Prof. F. J. M. Stratton, O.B.E.	47
Rh Gene Frequencies in Britain.—Prof. R. A. Fisher, F.R.S., and Dr. R. R. Race	48
A New Mutant of *Saccharomyces cerevisiae*.—Dr. M. K. Subramaniam and B. Ranganathan	49
Peculiar Cytological Behaviour of a Distillery Yeast.—Dr. M. K. Subramaniam and B. Ranganathan	50
A Specific Effect of High-Frequency Electric Currents on Biological Objects.—Johan E. Nyrop	51
The Scientific Civil Service.—Sir Paul Fildes, O.B.E., F.R.S.	51
Recent Genetical Experiments with Yeasts. By Eva R. Sansome	52
Restoration of Science in Austria. By Dr. E. Broda	53
Haemoglobin Levels in Britain. By Dr. G. Lapage	54

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DOCUMENTARY REPRODUCTION

THE article on documentary reproduction as an aid to science and learning which Mrs. Moholy contributes to this issue (p. 38) is concerned essentially with the potentialities of microfilm. The technique of microfilm had not been widely adopted in Britain up to the outbreak of war, although it was already being largely used in the United States, as Dr. L. A. Sayce indicated in his paper, "Microphotography in 1939", prepared for the sixteenth annual conference of the Association of Special Libraries and Information Bureaux. One reason for this lag in Britain—the absence of cheap and convenient viewing apparatus—was well brought out in the discussion on Dr. Sayce's paper, and the situation in this respect has not fundamentally changed in the intervening years. Moreover, even when—and if—a portable viewer meeting these requirements is available, microfilm will always be at a disadvantage compared with other processes of documentary reproduction, such as the photostat, where the research worker is concerned, because the microfilm copy cannot be taken away and read at home or where most convenient in the same way that the original or photostat copy can.

It is important, therefore, to consider the inherent drawbacks of any particular technique of documentary reproduction before discussing any large schemes for its utilization and further development. The particular drawback just considered does not of course apply to all the uses which have been made of microfilm in Britain during the War : for example, to the microcopying of documents as insurance against danger of loss by fire or enemy action, or the airgraph letter service. Further, it in no way detracts from the value of the microfilm service which Mrs. Moholy directed during the War for copying enemy periodicals, to point out that the photostat full-size copies of such periodicals are far more appreciated by the reader than the microfilm itself. The discontinuance of the airgraph service is a pointer in the same direction, and it may be questioned whether the British Council's microfilm service of British periodicals for China will be maintained when either the transport or the paper situation is less acute.

From such experience one might well conclude that the future developments and potentialities of microfilm will lie rather in those fields where the question of bulk or weight and storage is important under normal conditions ; and where the microfilm itself is the intermediary of supplying the reader's requirement rather than the actual document handled by him, at any rate unless such consultation or handling is rare or conveniently and reasonably limited to within the institution holding the microfilm. The programme of tasks awaiting attention which Mrs. Moholy has drawn up contains plenty of examples where microfilm might well meet the need, though for some, such as the publication of scientific papers which cannot be accommodated in existing periodicals, or the distribution of research material, it

appears to be premature, if not mistaken tactics, to approach them first from the angle of the technique to be applied. There are larger questions of publication policy and co-operation which must be solved first before we can consider the technique by which effect can most appropriately be given to the decisions taken.

In spite of this, it must be said that Mrs. Moholy's article directs attention to a new technique which provides an additional reason for a fundamental reconsideration of the present practice in regard to the publication of scientific papers and the dissemination of scientific and technical information generally. Difficulties in the way of distributing the comparatively small number of copies of detailed papers dealing with some highly specialized field might well be overcome with the appropriate use of one of the new techniques of documentary reproduction. The possibilities of collaboration in regard to abstracting services and the like are considerably increased, and the whole attitude of scientific workers to such problems needs to be re-examined in the light of the new tools that now lie to hand.

As Mrs. Moholy points out, for effective use to be made of microfilm or other techniques of documentary reproduction some co-ordinated effort will often be required, and very frequently on an international scale if the full advantages of the new techniques are to be reaped. Questions of copyright will arise in any use made of the documentary reproduction for the restocking of libraries damaged, depleted or destroyed during the War, and possibly even when it is utilized to minimize the deterioration of valuable documents through frequent handling. The provisional agreement on the microfilming of books to which Mrs. Moholy refers and which was published in *The Bookseller* of July 27, 1944, may cover the situation with regard to the re-publication of out-of-print books for which the demand is too small to justify new editions; but attractive though the use of microfilm appears to be for the distribution of such relatively inaccessible material as university theses and dissertations, the limited demand for which may not justify the cost of typesetting, there are difficulties even here. Practice in Britain varies widely, and both here and in the United States and such countries as Germany and Switzerland, the substance of theses submitted for a university degree may be published later as a paper in some scientific or technical periodical.

Clearly these possibilities demand discussion and careful consideration from both the production or publishing and the reader's or user's side. Mrs. Moholy has done no more than touch on some of the possibilities and problems involved; but her article should stimulate constructive thought in a field which it is clearly desirable to re-examine with open minds free from any inhibitions of past practice and concerned merely to select the most appropriate means of dealing with the situation in the light of the new knowledge and resources. It may well be true that a conference such as those held annually by the International Institute of Bibliography (now the International Federation of Documentation) up to 1939 would be a useful means of clarifying thought and securing concerted action; but Mrs. Moholy appears to be going too far at present when she suggests that permanent offices should be set up in all countries to act as centres of organized national systems of co-operating institutions in this particular field of documentary reproduction.

It is sound policy not to create new organizations or institutions where existing ones will serve, and the first task is undoubtedly to arouse the learned and scientific societies and publishing institutions, as well as the appropriate libraries, to reconsider their practice and activities in the light of the new techniques, both severally and collectively. Some stimulus in this connexion may well come from the new United Nations Educational, Scientific and Cultural Organisation, particularly if that body addresses itself first to such urgent practical tasks as the restoration of the old freedom of exchange between the cultural leaders of the different nations, with all its apparatus of books, buildings and a system of cultural communications, so badly battered in what may fairly be termed the thirty years war of the twentieth century. The new Organisation must in fact limit itself at first to this severely practical task of educational, scientific and cultural reconstruction in devastated countries.

By such a course the United Nations Educational, Scientific and Cultural Organisation would avoid the most serious danger confronting it, namely, diffusing its activities and resources too widely, and might succeed in bringing fresh vitality to the existing international unions for certain branches of science and, particularly, assist in providing them with adequate secretariat. Thus equipped, such international unions, particularly with the formation of a few new ones to cover other fields of science and with the assistance of science co-operation offices on the lines of those established in London, in Washington and in Chungking during the War, might be able to promote much of the international co-operation in the field of documentary reproduction which Mrs. Moholy suggests. Documentary reproduction is only one special aspect of documentation and the interchange of information, and as such its development in the international sphere would fall naturally within the scope of a science co-operation service, whether or not it be on such elaborate lines as those suggested by Dr. J. Needham. It may be taken for granted that such problems will be considered, so far as Great Britain, the Dominions and the Empire are concerned, by the Imperial Scientific Conference next year. Meanwhile the demonstration in such schemes as those sponsored by the American Council of Learned Societies, the ASLIB Microfilm Service and the British Council that microfilm reproduction has been able to meet the emergency demands of war-time should stir men of science, along with others concerned with the advancement of knowledge, to consider what effective use could be made of these new techniques in dealing with problems of peace and cultural reconstruction and development in the widest sense.

SOIL CONSERVATION IN INDIA

Erosion in the Punjab, its Causes and Cure

A Survey of Soil Conservation. By Sir Harold Glover. Pp. ix + 143 + 115 plates. (Lahore : Civil and Military Gazette, Ltd., 1944.) 15.7 rupees ; 23*s*.

It is well known in India at least that the Punjab has been paying serious attention to its soil conservation problems during recent years, as well it might in view of the spectacular progress of erosion and the combination of circumstances all tending towards its acceleration—rapidly increasing population, increasing head of livestock, friable soils, seasonal and rather low rainfall. The book under review sets out to take stock of the position throughout the province, to make it clear how great the losses have already been, to show what measure of success in counter-erosion work has already been attained, and finally to indicate how much remains to be done, and suggest how it can be done. Two extracts may be quoted from the preface and foreword respectively to illustrate the keynote of the conclusions reached. "It is scarcely possible to exaggerate the danger of permitting it [soil erosion] to advance still further. The disease has been diagnosed and effective remedies have been prescribed. . . . Where the life of the whole province is imperilled, no individual can be allowed through selfishness or indifference to stand aside." "The success or failure of soil conservation measures will depend on the extent to which they enlist the assistance both of nature and of the humble tiller of the soil and the still humbler shepherd and goatherd."

One third of the book is taken up by a general review of the subject beginning with a brief account of the country and of its soils, vegetation and climate, which gives a useful background for the reader who has little or no personal knowledge of the province. The causes of erosion are surveyed with an interesting account of the local grazing practices that are clearly at the root of the whole matter and require the closest study and most careful handling. Next come the effects of erosion, with a most formidable array of the very real threats that hang over the province if it does not reform its ways and put its house in order. Admittedly some of these threats are more the consequence of denudation of vegetative cover than of loss of soil; but the separation of this category makes little difference to the overall picture. The risks to the vital irrigation works, hydro-electric plants and communications are well brought out, and would in themselves justify heroic measures. Probably the chapter on the cure for soil erosion will be the most interesting to those concerned with soil conservation, and here the principles mentioned in the quotations given above are further developed. Every rural agency that can help in any way should be used to promote amelioration by persuasion rather than compulsion, though there are cases where compulsion may be unavoidable ; co-operative societies, village councils, and all forms of public education are roped in to help. The general forest policy adopted by Government especially with regard to rural economy and uplift is closely related and is discussed somewhat cursorily. In view of the general tone of optimism of the book as a whole, it is rather depressing to find it stated that, in the author's opinion, in four important districts the doom of the reserved forests is certain (p. 41) now that the village forests no longer suffice for the villagers' needs.

A further object of the book was to review the work of the newly formed Soil Conservation Circle of the Forest Department at the end of its first quinquennium. The author—and presumably his influential sponsors writing preface and foreword—are satisfied that it has thoroughly justified its existence. Further planning is accordingly outlined calling for more than doubling the present staff of fully qualified officers, with subordinate staff in proportion. This additional staff would cost about £40,000 annually. Estimates are also provided for buying out grazing rights where this is unavoidable (about £50,000) and for the Government share of co-operative work in terracing, etc. (about £300,000). The total expenditure recommended is £400,000 annually for the next fifteen years in the northern districts only, and may be related to the demobilization and employment problems now upon the province.

The latter two thirds of the book are devoted to a more detailed account of the position in individual districts. This method of treatment admittedly results in a good deal of repetition, but we believe a useful purpose will have been served apart from the considerable value of these summaries as historical records. A lesson is far more effectively brought home to the individual if it can be illustrated by instances close at hand and familiar to him, and that goes for many who hold much more influential positions than the village farmer. We would also recommend the general reader not to skip these chapters, for every one of them has additional points of interest of which only a few instances can be quoted; for example, the favourable results of partition and enclosure of the *shamilat* lands in Jhelum and the reverse in Murree, the tremendous number of forest offences in Murree municipal forests, the decrease in size of holdings in Rawalpindi and efforts towards consolidation of holdings in both plains and hills, the success of village forests, societies and co-operatives in Kangra, and so on.

Having made it clear that this book is a valuable addition to the literature of the subject, one may be permitted to make a few comments for consideration in any future re-issue. Paper, shape and size could all have been better, and there is no map of any sort. A brief index would be much more useful than the appendix, which has only a very slender connexion with the rest of the book. Few publications, especially during war-time, can have been so profusely illustrated, and a great many of the photographs used (mostly of the author's own taking) are exceptionally well suited to bring out the points in question, so much so that it is scarcely possible to single out any for special mention, especially as they are not numbered, and one cannot even quote the page they face as they are inserted in groups. The aerial photographs are a valuable addition. In this field, there are few more telling records than the 'before' and 'after' of the same scene; but though there are many pairs which suggest they are this, it is not stated that they are (or even might be) and there are a few with a strong flavour of unintentional *suggestio falsi*. One or two have obviously been included just because they are pretty pictures, which is rather unnecessary, and there are some weak repetitions (for example, the last in the book and one of those following page 15). The editing is not all it might be, which is probably ascribable to war conditions ; thus the glossary has several spelling mistakes in the scientific names, and apparently the author never made up his mind how to spell Tallagang or *Dicanthium*. Foresters in the adjoining

United Provinces will scarcely agree that dense sal forests characterize their Siwaliks, and many people will dislike reading about 'agriculturalists', but these are minor matters. Finally, a suggestion, if it has not already been made and acted on. The chapters on individual districts should be separately published, perhaps in rather more 'popular' form, and distributed locally as freely as possible. H. G. CHAMPION.

DESCARTES' PHILOSOPHY

The Dream of Descartes

Together with some other Essays. By Jacques Maritain. Translated by Mabelle L. Andison. Pp. 220. (New York: Philosophical Library, Inc., 1944.) 3 dollars.

IN the five essays here translated into English (rather queer English in places) Prof. J. Maritain attacks the philosophy of Descartes; in some ways very unfairly. The first essay deals with the ecstatic experience Descartes had as a young man; an experience that is scarcely relevant to his philosophy, however important to him personally. Prof. Maritain, expanding hearsay (the only evidence available) with conjecture, decides that the upshot was, not a mathematical discovery as often supposed, but the notion of a single comprehensive science of complete certainty. In the second essay, in order to show that Descartes believed in such a science, he has to quote scraps from early unpublished work ("Regulæ") and private letters. There is nothing about it in Descartes' mature published work. In any event, the idea was scarcely an innovation calculated to disrupt the unity of Christian thought, as Prof. Maritain suggests, since it is to be found in Plato's "Republic", a book not without influence on Christendom. In the third essay the author objects, very eloquently, to Descartes' *a priori* theory of what theology ought to be, by opposing to it another equally *a priori*; without stopping to consider the only relevant question, what, as a matter of history, theology is.

The last two essays are far more valuable. They contain an acute examination of Descartes' use of the arguments for the existence of God, which is the very centre of his philosophy, and a hostile but not too unfair survey of his influence on subsequent thought. Prof. Maritain rightly stresses the unfortunate effect of Descartes' lapse into the doctrine that ideas are representations or pictures of existents, but speaks as though Descartes invented it; whereas it must have been already current. The Epicureans and even other Greek thinkers held it; it was bound to arise out of medieval nominalism, and it has probably always been the basis of common-sense thinking. Nevertheless, Descartes ought to have known better, and occasionally shows signs that he did. Prof. Maritain allows him no credit for this.

However, what one chiefly misses in his treatment is the realization that the greatness of Descartes lies in the questions he asked, not in his hasty answers; and in one question especially. Granted that what makes a truth true is that the thought in some way corresponds with its object, with fact or reality; Descartes saw that correspondence is itself no criterion of truth, which criterion cannot in the last resort be external. It must be internal and revealed to the individual thinker in the process of thought itself. The question then is: How is it revealed? The question is an awkward one for all who are not prepared to accept the Hegelian solution, and Descartes has no more than half an answer. Aristotle and St. Thomas have no answer, but as they never asked the question we cannot blame them. We can blame their modern disciple, Prof. Maritain, for shirking the question, repeating formulæ (pp. 142-143, 146, 169) which have no value without a proper answer, and then being unpleasant about Descartes.

A. D. RITCHIE.

PHOTOGRAPHIC TECHNOLOGY

Photography in Engineering

By C. H. S. Tupholme. Pp. xv+276+188 plates. (London: Faber and Faber, Ltd., and the Hyperion Press, Ltd., 1945.) 42*s*. net.

IN his latest volume Mr. Tupholme has turned his attention to photography, and has collected and tabulated information from a very wide field in industry. The purpose of such a volume is to indicate to the busy engineer and executive what types of scientific apparatus have been developed for recording by photographic means the very considerable and important information required for industrial and technical processes. On the other hand, scientific workers, who are perforce working in narrow fields, often must have recourse to such a text in order to be prompted to devise their work in such a way that their results can be recorded with the desired degree of accuracy, and so be saved considerable time in devising recording methods of their own. There is no speculation in the present text, the information having been obtained from many sources, particularly British and American. The copying of prints, drawings and documents forms the first chapter, and it is evident that considerable progress has been made. Indeed, the old blue-print of industry has been almost entirely superseded by dyeline and photostatic methods. Of major importance is the very extensive use of photographing the images of drawings on sensitized sheets of metal for subsequent drilling or shaping. In the laboratory there are many uses of photography; the author outlines the regular methods of spectroscopy in rapid analysis, the use of polarized light, reflex photography on sections, and the general method of studying isochromatic lines arising from stresses in celluloid outlines of typical engineering sections.

An interesting application of photography is in the fish-eye camera which photographs an image of the surrounding room so that the area of images is proportional to the relevant illuminations from the objects. The electron microscope and the apparatus for electron diffraction, particularly the Finch designs, are explained in detail. The rapid advance in X-ray and electron diffraction and micro-radiography is demonstrated by the author's collection of more than one hundred distinct industrial applications.

In the field of high-speed photography, special lamps have been devised which give almost unthinkable illuminations for the brief periods required for analysing high-speed phenomena. Among their applications, that of cutting with a tool on a lathe and finding the correct rake angle is described in detail. A novel method of triggering such lamps is to pick up a noise at a suitable distance with a microphone.

In radiography the application of high-voltage tubes has been very extensive during war-time, particularly detecting flaws in castings of all descriptions and in built-up structures, such as thermionic

valves. A technique of shifting the tube sideways has been developed for finding the depth of flaws. Intensive development has been made in portable X-ray apparatus so that the tube can be taken to the job, such as aircraft propellors, instead of vice versa.

The author concludes with a short discourse on the use of motion pictures for recording engineering work, for instructing operatives in correct technique, and in the kinds of commercial publicity required in the modern world. Throughout the text the author invariably supplements his observations with concrete suggestions for practical procedure in photographic development, lighting conditions, and the selection of photographic plates and films. Each chapter contains references to suitable publications and suggests particular applications of the available apparatus described. Much of the technique has been evolved or perfected during the War, but there remains, of course, much further information to be disclosed.

L. E. C. Hughes.

THE MENACE OF DECLINING POPULATION

Nation and Family

The Swedish Experiment in Democratic Family and Population Policy. By Alva Myrdal. Pp. xiv+445. (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1945.) 21*s*. net.

IN commending this important book to the attention of readers in all countries that call themselves democratic, the editor and publishers point out, quite rightly, that the "problems of population and family are very much alive in British discussion to-day". From a long list of authoritative workers in this field it may be sufficient for us to mention Carr-Saunders, Enid Charles, D. V. Glass, the late Beatrice Webb and R. and K. Titmuss, whose clear and comprehensive little book, "Parents Revolt", gives an admirable summary which he that runs may read.

In Sweden, where the pre-war birth-rate closely resembled that of England, interest in questions of population had been steadily increasing when, in 1934, Prof. G. Myrdal and his wife Alva Myrdal published "Crisis in the Population Question", a book which had a sale rivalling that of a popular novel. A Royal Commission was appointed to make detailed investigations and to report. Many of its recommendations were soon passed into law during a session of the Swedish Parliament, since known as the "Mothers and Babies" Parliament.

Now comes this extensive and thorough scientific treatise entitled "Nation and Family", written by Alva Myrdal. The author discusses the import of population figures in their bearing on economics, productivity, and the well-known gradual change to an 'age-ing' community, with its growing proportion of old folks and its dwindling proportion of little folks. She proceeds to set forth in general terms of political ends and means a programme for the adjustment of a nation's life to that of its families. The latter part of the book includes an account of welfare reforms in Sweden, and a discussion of birth-control, of housing, of social insurance, of education, of provisions for child-birth, and of the 'place of women' and the structure of the modern family.

So much for this very important book, an entirely worthy addition to the "International Library of Sociology and Social Reconstruction" edited by Dr. Karl Mannheim. The book stirs a crowd of reflexions in the mind of one who has followed the relevant literature. Long ago, Abraham Lincoln said to his fellow countrymen: "I look for a time when money will cease to be the master and become the servant of humanity". For years his words fell on deaf ears in his own country and in others, but we have reached a time when, at least as regards the children, money has become the servant, not the master. The Myrdals hold that in a truly democratic society all sections of the people should have easy access to information about birth-control, in order that undesired and undesirable births should be reduced; that we cannot accept a way of things whereby the poor and ignorant maintain the stock of the population; that we must direct our attention to the abolition of both poverty and ignorance, the very factors which have for a long time stimulated a high birth-rate.

T. Raymont.

ESSAYS ON BIOLOGY

New Biology

Edited by M. L. Johnson and Michael Abercrombie. 1. Pp. 118+8 plates. (Harmondsworth and New York: Penguin Books, Ltd., 1945.) 9*d*.

THIS book consists of seven articles all written by well-known authorities in their respective fields and dealing with a variety of biological subjects. According to the preface they are intended for the general reader who has had some preliminary training in biology, and it is suggested that they may be interesting and useful to teachers of science in schools.

It may be said that all the articles are well written and the subject-matter well and clearly presented, but it is doubtful whether some of the more difficult subjects such as "The Function of the Central Nervous System" by Dr. J. Z. Young, or "The Anatomical Basis of Sensory Experience" by Prof. Le Gros Clark would really serve as an aid to non-specialist teachers in schools.

Other essays such as "The Potato: Master or Servant" by Dr. Salaman, "The Measurement of Human Survival" by Prof. L. Hogben and "Malaria Mosquitos and Man" by Dr. M. N. Johnson might well be appreciated by the general reader, for they require less biological background.

The lack of continuity and relationship between the subjects covered by these essays is a disadvantage, and one feels that a long introductory training is necessary before some of the material can be assimilated.

Whether the references to various specialist scientific journals would be profitable to those who only have a slight acquaintance with biological work is doubtful.

It is stated in the preface that this little book may be the first of a series. If so, it is to be hoped that the future volumes will be constructed on more fundamental lines and deal with subjects which are well within the range of "an audience already possessing some scientific knowledge whether through self-education or through school or University instruction". The realm of the biological sciences is so vast that there can be no difficulty in choosing subjects, which, while of fundamental importance and interest, can still be understood by those who have not had an extensive training in lecture room and laboratory.

Introduction à la biochimie générale

Par Prof. Marcel Florkin. Deuxième édition. Pp. 372. (Liège : Éditions Desoer ; Paris : Masson et Cie., 1943.) n.p.

Précis de biochimie humaine

Par Prof. Marcel Florkin. Troisième édition. Pp. 442. (Liège : Éditions Desoer ; Paris : Libr. Maloine, 1944.) n.p.

L'Évolution biochimique

Par Prof. Marcel Florkin. Pp. 210. (Liège : Éditions Desoer, 1944.) n.p.

Vitamines et carences alimentaires

Par Prof. Georges Mouriquand. (Sciences d'aujourd'hui.) Pp. 462+65 plates. (Paris : Albin Michel, 1942.) 98 francs.

L'Organisation nerveuse

Par Prof. Remy Collin. (Sciences d'aujourd'hui.) Pp. 530+40 plates. (Paris : Albin Michel, 1944.) 150 francs.

THE five books considered here are all war-time products of France and Belgium.

Prof. Florkin's two volumes on general and on human biochemistry are on standard lines, suitable for university students. His "Évolution biochimique" proposes to correlate a biochemical aspect of zoological evolution with the morphological.

Prof. Mouriquand's "Vitamines et carences alimentaires" is especially recommended for its concise descriptions of the vitamins, their assay, properties and effects. The interrelation of the vitamins with other dietetic factors at different ages is considered separately, and this offsets the impression, so often given in popular books on this subject, that vitamin-deficiency diseases are always clear-cut entities.

Prof. Collin's "L'Organisation nerveuse" is a description of the embryological formation and of the histological and anatomical structure of the nervous system in relation to its function.

These last two volumes are well illustrated and are excellent additions to the series "Sciences d'aujourd'hui" which many will remember from pre-war days.

De la stratosphère à l'ionosphère

Par Daniel Barbier et Daniel Chalonge. (La science vivante, No. 4.) Pp. 156+8 plates. (Paris : Presses universitaires de France, 1942.) 25 francs.

THIS little book, published in Paris in 1942, under the German occupation, is a most fitting member of the series "La Science Vivante". It describes a realm of science the exploration of which has in the main been accomplished during and between two great wars. As in most fields of science, men of many countries have shared in the work, bringing to it knowledge and skill of varied kinds—meteorologists, physicists, mathematicians, astronomers, chemists, radio-physicists among others. Researches undertaken mainly under the impulsion of individual interest in particular aspects of the upper atmosphere have gradually converged to form a body of knowledge already largely coherent and mutually confirmatory, though many problems still remain. The subject proves to be rich and multifarious in detail and variety, and in many ways its investigation has great promise (and much present performance) in rendering practical aid of economic value in human affairs. This admirable little book gives a clear and wide summary of the subject, and though no two men can be really expert in so great a variety of studies, the authors have omitted little of special interest, and show good judgment in their occasional critical pronouncements on the more disputed topics.

In their closing chapter on the problems of the future, the authors stress the need for extending past attacks (which have in the main been individual or only slightly co-ordinated sorties on particular points) according to a grand strategy embracing the whole globe. The following words on the problems of the future have an application not confined to France, where signs of new life and activity are indeed manifest in many fields of science : "Can one make it known in high places that scientific research is stifled in the scanty bounds of old laboratories, old observatories, dusty and out of date, in which French men of science vegetate in an atmosphere of another age ; and that it requires equipment on an industrial scale, and many technicians". In the words of ancient wisdom : There is that scattereth, and yet increaseth ; and there is that withholdeth more than is meet, but it tendeth to poverty.

The Mathematical Discoveries of Newton

By Prof. H. W. Turnbull. Pp. vii+68. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1945.) 5*s*. net.

THIS little book is based on two lectures delivered about three years ago, the first at the Newton tercentenary meeting of the Edinburgh Mathematical Society, and the second at a subsequent meeting of the Mathematical and Physical Society of the University of Edinburgh. It is not concerned with Newton's work on gravitation or optics, but solely with his pure mathematics, and is addressed to those who have themselves a certain knowledge of this subject. The twelve sections deal respectively with early influences, the binomial theorem, the method of fluxions, the "De Analysi", the "De Quadratura", the "Geometria Analytica", the solid of least resistance and the curve of quickest descent, angular sections, interpolation and finite differences, the "Arithmetica Universalis", cubic curves and geometry in the "Principia". Certain conjectures have been confirmed from a closer study of the works of Wallis and of the manuscript papers of Newton's friend, David Gregory. The author does not deal with the controversy between Newton and Leibniz as to who discovered the calculus, considering it unnecessary to add to the long-existing discussions of this subject until all the relevant documents on both sides have been published.

Trees and Shrubs of the British Isles

By N. Barrie Hodgson. (Crowther's Rambler's Books.) Pp. 82 (19 plates). (Bognor Regis : John Crowther, Ltd., 1945.) 6*s*. net.

THIS book is one of a series on common plants and animals, most of them being concerned with enabling the amateur to recognize the more familiar types. The present volume deals with fifty-nine native and introduced trees and shrubs. The choice of species is good ; but if the whortleberry is included as a shrub then there are several other plants which have equal claims.

The illustrations are of rather unequal merit, but with the description they will probably enable anyone to recognize the trees described. As there is no key the identification depends on comparison with the illustration. This method must be deplored, but the descriptions are in the main good and do give in some detail the characteristics of the bark and the buds. The general form of the book is pleasing.

INTERNATIONAL GENETICS CONFERENCE

AN international genetics meeting took place during October 31–November 2 in London, the first to be held there since the conference in 1906 when Bateson first named the subject 'genetics'. Dr. C. D. Darlington, president of the Genetical Society, in welcoming the foreign visitors, said that after the First World War it had taken nine years to arrange an international gathering. On this occasion it had been possible in nine weeks. For this they were indebted to the help of the British Council, the French Scientific Mission, and the happy coincidence of Prof. Muller's Pilgrim Trust Lecture to the Royal Society.

Dr. Darlington summarized the development of plant genetics in Britain since 1939 under four heads. The first was the important beginning that had been made by Pontecorvo in the study of the genetics of fungi, especially on mutation, and the action of special mating systems described under the term 'heterokaryosis'. This work, of course, was closely related to the pioneer study of Prof. Winge on the breeding of yeast, and the later work of Lindegren, Beadle and others on yeast and *Neurospora* (see p. 52 of this issue). There had been theoretical interest also in the American studies of cytoplasmic inheritance in these organisms, especially in its bearing on the origin of cancer and of virus diseases.

Second were the experiments of Mather on quantitative inheritance in plants and animals. Beginning with the analysis of selection, Mather had been able to develop Fisher's combination of genetics and statistics into a method of describing and predicting quantitative inheritance. His results, and the theory of polygenic behaviour based on them, were of the first importance for practical plant and animal breeding. But they seemed to be no less important for the theory of gene action and for the understanding of the physiological difference between heterochromatin and euchromatin.

Third was the study of induced mutation. Two kinds of work had been carried out. One was that of Catcheside and Lea, who had used different types of radiation, including neutrons, to discover the physical method of gene alteration and chromosome breakage. The other was that of Darlington and La Cour, who had been concerned in discovering what happened after the breakage of chromosomes as a means of more accurately recording when and where chromosomes were in fact broken. These observations seem to show that the attachment of nucleic acid to the chromosomes, an attachment organized by the centromere, governed both their breakage and their later reunion. The work of Auerbach and Koller on chemically induced mutation and chromosome breakage (using mustard gas) seemed to fall into line with this conclusion.

Fourth were direct studies of nucleic acid relations with the chromosomes. Originally these relations were known to be controlled by temperature. Koller had now shown that they were physiologically controlled in mammals, and La Cour had shown that differentiation in the quantity of nucleic acid supply in the cell was the basis of the differentiation of red and white precursors in the blood.

These developments, Dr. Darlington concluded, showed that, in place of the simple relationship of chromosomes and heredity, we now had a triple relationship between the studies of heredity, chromosomes and chemistry. There had been a new synthesis and this synthesis had been equally effective in developing the theory of the subject and in applying it usefully to the problems of agriculture and medicine.

Prof. J. B. S. Haldane, reviewing the advance in animal genetics, treated the groups in systematic order from Crustacea to man. He referred to Waddington's co-ordination of genetic abnormalities with the crises of development in flies, and to Ford's experiment in which selection changed the dominance of a naturally occurring mutant gene of the moth *Abraxas*. He described Fisher's theoretical and experimental studies with inbreeding in mice. Philip had found stocks of *Drosophila subobscura* growing in Nature which were heterozygous for inversions of pieces of chromosome and maintained this heterozygous condition on inbreeding for several generations. They were, therefore, like some species of *Œnothera*, true-breeding hybrids of a kind not previously known in animals. He pointed out that Kalmus had confirmed the French discovery of the cytoplasmic inheritance of sensitivity to carbon dioxide in *Drosophila*. In man, new data on crossing-over between hæmophilia and colour blindness gave them 10 per cent recombination. In man also the new work on the *Rh* gene, which causes death of newborn babies, had shown that, of the eight allelomorphs and six anti-sera which Fisher predicted, seven allelomorphs and five anti-sera had now been described either by Race or by workers in the United States.

During the War also the work of Gordon and Sang showed that *Drosophila melanogaster* homozygous for the gene 'antennaless', nevertheless grew antennæ if provided with a sufficient supply of vitamin B_2. In other words, the mutant gene fails to carry out a specific chemical process, a situation analogous with that described by Beadle in *Neurospora*.

Dr. Julian Huxley discussed the development of genetics in Great Britain in relation to systematics and ecology. Ford had shown that the chemistry of the pigments in butterflies' wings varied with their systematic grouping and in some cases enabled previous classifications to be rectified. Crosby had found a population of primroses in which a gene for homostyly appeared to be becoming fixed, replacing in part, at least, the normal heterostyle condition. Finally Lawrence's work on the differentiation of the species of *Streptocarpus* in south and south-east Africa seemed to be of outstanding importance for the theory of systematics. Dr. Huxley also referred to the case of the hooded and carrion crows, between which there was an interbreeding boundary two thousand miles long but only a few miles wide. This boundary was shifting southwards but remained narrow on account, it seemed, of the upset of polygenic balance which acted against the propagation of the hybrids.

A session on plant breeding was opened by Prof. Ø. Winge (Copenhagen), who described work he had carried out since discovering the processes of sexual reproduction in yeast. These processes made hybridization and systematic breeding possible. Apart from the ordinary segregation and re-combination resulting, he found a series of mutants, some of which were already in use for the production of new brewers' and bakers' yeasts. The mutant sectors of monosporous and single-cell cultures showed the characteristic expanding and contracting shapes owing to

their changes in growth-rates relative to the original types.

Prof. M. J. Sirks (Groningen), who was working under extreme difficulty in Holland during the War, gave an account of the work he now has in hand. This related to species hybrids in *Verbascum* and *Phaseolus*, genetics and chemistry of flower colour in *Vicia*, where the pigments are not anthocyanins, and the breeding behaviour in an aberrant wild toadflax (*Linaria*).

Prof. A. Müntzing (Lund) reported his studies on tetraploid rye which gave very favourable crop yields provided it was separated from diploid rye: the cross between diploid and tetraploid occurred very readily and it was successful in producing an embryo but unsuccessful in producing a grain. He also discussed the types of rye with supernumerary chromosomes which exist in stocks of these plants throughout the world. He showed how the chromosomes were distributed to the generative nucleus of the pollen in disproportionate frequency and suggested that this gave them an unfair advantage in competition. This advantage was offset by their physiological disadvantage in reducing vigour and fertility. He therefore looked upon these chromosomes as piratical intruders in the genetic system of this plant.

Prof. Müntzing also described the astonishing discovery of a plant species, a diploid grass *Poa alpina*, which lost its supernumerary chromosomes in the roots. Such chromosome-diminution has long been known in the thread worm *Ascaris*, and has recently been found in another grass, a diploid *Sorghum*. The wheat-rye hybrid (*Triticale*) had given good results for baking quality, but so far indifferent yields. Gustafsson was making progress in barley breeding with the help of X-ray induced changes.

Dr. S. C. Harland (Lima) pointed out that in the castor oil plant the glaucous gene was rare on the coast of Peru, rapidly increased inland, and was present up to a height of 8,000 ft. The special equilibrium on the coast was correlated with the unusual climate of this narrow strip, which presented many problems of genetic interest. Native Peruvian peas which had existed as isolated races in the mountains since the Spanish conquest were extremely heterogeneous, and had been found to contain a recessive gene conferring immunity to mildew on them. This could be transferred to imported varieties.

The European potato differed genetically from Peruvian potatoes in regard to its photoperiodism. When brought back to Peru it grew no more than two inches high and produced tubers the size of peas. The European-Peruvian hybrids segregated sharply for this genetic difference. This evidence favours Chile as the main source of origin of European cultivated potatoes.

In a *Drosophila* session, Prof. O. L. Mohr (Oslo) described how he had been able to distinguish between the effects of deficiencies and lethal mutations in *Drosophila* by studying the comparative effects of different doses in triploids and in translocation hybrids.

Prof. B. Ephrussi (Paris) used deficiencies for another purpose. He sketched the evidence which distinguishes the physiological interpretation of the position effect in *Drosophila*, and his own interpretation. This assumes that the position of the chromosomes in the resting nucleus, being determined by somatic pairing, is abnormal in a structural hybrid. The chromosomes are, therefore, distorted mechanically as a result of their breakage, and their physiological action is correspondingly upset. The position effect has also been shown by Catcheside in *Œnothera* where somatic pairing does not occur. Dr. K. Mather suggested that the mechanical theory might apply with duplications within the chromosome, but Dr. D. G. Catcheside doubted whether his data agreed with this view. Prof. H. J. Muller described the work of Prokofieva on the conversion of the euchromatic to the heterochromatic state by the proximity of large masses of heterochromatin. These observations offered one possible explanation of the position effect.

Prof. P. L'Héritier (Strasbourg) explained the inheritance of sensitivity to carbon dioxide in *Drosophila*. He showed that this sensitivity was predominantly, though not exclusively, maternal in its inheritance. Since it showed no regular segregation it must be considered to be cytoplasmic in its determination. It could be cured, however, sometimes temporarily, sometimes permanently, by heat treatment in early life. Dr. H. Kalmus explained that he produced the same cure by cold treatment. Prof. L'Héritier attributed these effects to an upset in the rate of development of cells relative to the rate of multiplication of plasmagenes produced by differences of temperature.

Prof. G. Teissier (Paris) described his experiments in maintaining mutant and wild-type populations of *Drosophila* in mixed culture. He was able to measure the competitive power of the different genotypes, some of which disappeared while others reached equilibrium. Cyclical changes in gene frequencies also occurred under conditions in which the survival rate was usually about one in ten. The experiments provided an experimental explanation of polymorphism and also of the rapid spread of new mutants in Nature.

Prof. J. Brachet (Brussels) outlined the work he had done on the concentration of ribose nucleic acid in the eggs of sea urchins and chicks in relation to the action of organizers in development, to evocation, and to the concentration of the dexosyribose nucleic acid used in the manufacture of chromosomes. He showed that the two forms of nucleic acid were fairly readily convertible. This work has depended on the use of ribonuclease and other enzymes as means of discrimination. The results agree with those reached simultaneously by Caspersson in Sweden, in showing that ribose nucleic acid is present in the nucleolus and in the cytoplasm, particularly in the ergastoplasm. There is a constant relationship between high ribose nucleic acid content and active protein synthesis in the cell. Ribonucleoproteins are present in the cell as small granules containing also important respiratory and hydrolytic enzymes. These granules may well play an important part in protein synthesis, and thus have some relationship with plasmagenes.

In a session on animal breeding Prof. A. L. Hagedoorn (Soesterberg) discussed the selective modification of dominance in poultry and mice. The autosexing property in poultry depends on the action of the barring gene in birds which have no black pigmentation. Barring is dominant in black birds, intermediate in Brown Leghorns, and nearly recessive in Rhode Island Reds. He had produced new types in various animals by hybridization and recombination as opposed to mutation, for example, the waltzing ferret, from a cross of ferret by fitch (polecat). Prof. Hagedoorn also described the strange case of the whisker-eating gene in mice which reveals itself only by the absence of whiskers in the individual's cage mates.

Prof. G. Bonnier (Stockholm and Wiad) showed how he used the collection of identical twins he had made in cattle. Some thirty pairs of twins had been subjected to differential feeding treatments and the effects recorded in regard to both growth and milk-yield. So far it had been shown that improved nutrition had a greater effect with some genotypes than with others. His results also showed that higher milk production was accompanied by slower growth, so indicating that the total physiological activity of the cow was limited, one increase only being made at the expense of another. With regard to these treatments, Dr. J. Hammond pointed out that age in cattle could often be more usefully measured in terms of development rather than time. Clearly Prof. Bonnier's experiments were of theoretical as well as practical value.

Several speakers referred to their work on human heredity. Prof. Mohr had studied the occurrence in Norway of a form of mental deficiency with a biochemical basis; that of failure to oxidize phenyl pyruvic acid in the kidneys. The whole medical profession of Norway had been circularized with the view of obtaining complete information on the occurrence of this hereditary defect. The results showed that it was concentrated especially in certain inbred island populations. The view that the gene determining this form of imbecility was an autosomal recessive, as advanced by Penrose, was confirmed. Prof. L. S. Penrose pointed out that the incidence of this defect was highest among the Nordic Europeans, although it occurred also among Africans.

Dr. Harland gave some results of his studies on human heredity in Peru. He said that the continuous eyebrow character, common in Spain, and favoured by Persian portrait painters, is fairly frequent in the Indian population of Peru, and seems to be inherited as a conditional dominant. Another character found only in isolated mountain populations was that of mottled finger-nails, the inheritance of which he had not yet determined. Both Prof. Mohr and Dr. Harland emphasized the value of isolated and inbred populations in the study of abnormal types and conditions in man.

Discussion

In addition to papers on work in genetics, there was a discussion on the future of genetics. Dr. Darlington said that thirty years ago Mendel had seemed the exclusive progenitor of genetics; recently Darwin had been admitted as of equal importance, and very soon we might feel required to add Pasteur's name to the genealogy of the subject. The rapid expansion of genetics required some thought for the future. This expansion was taking place in different countries in different ways. Now was therefore a specially favourable moment for discussing the new applications of genetics to teaching and research and its new combinations, with physics and chemistry and with agriculture, medicine and sociology.

Dr. Huxley opened the discussion with an account of developments during recent years. He pointed out that the close union of genetic experiments with the study of physiology, embryology and systematics, of ecology and biochemistry, required a new outlook in both teaching and research. A new unity, in which evolutionary theory again played a prominent part, had been established and this could be of the utmost service to scientific thought.

Dr. U. Philip and Dr. M. J. D. White maintained that there was still great value to be attached to the formal and independent pursuit of specialized branches of the subject. They pointed out that the internal co-ordination of genetics and cytology alone gave great scope for future research. Dr. C. H. Waddington emphasized the dominant position of genetics in the organization of the modern study of life, a position which had only been acquired in the last ten years. He pointed out that wherever you started from you arrived at genetics. Whether you began with form or with function, genetic methods were necessary for the ultimate solution of your problems.

The foreign guests described the different methods by which genetics had developed in their different countries.

Prof. Winge pointed out that in Denmark genetics owed its origin to Johannsen, who was already teaching the subject in 1903, although a chair was only created in Copenhagen in 1921. The development of genetics in Sweden, Prof. Müntzing showed, arose from the practice of plant breeding, which was indeed also the foundation of agricultural research in Sweden. The importance of genetics for this work was discovered by Nilsson-Ehle, who was already carrying out genetic experiments after a visit of Tschermak in 1901. In consequence, genetics began at Svalöf. It was permanently established, however, in the neighbouring University of Lund when Nilsson-Ehle became professor of genetics there. In addition to Svalöf, there were many other plant-breeding stations in Scania distributed around Lund. There was the Weibullsholm seed-breeding station, the Hilleshög sugar-beet station, a new forest-tree breeding station at Ekebo, and a fruit and vegetable breeding station at Alnarp. Moreover, there were the Svalöf filial stations distributed over the whole of Sweden and the important new station at Ultuna directed by Prof. Turesson. Animal breeding was concentrated in the hands of Prof. Bonnier at Wiad and at the Stockholm University College.

Prof. Ephrussi described an entirely different situation in France. Here there had, in the past, been no organization for teaching or research in genetics. In the new plans for the development of research in France, genetics was to play a significant part. A chair of genetics had been newly created at the Sorbonne to which he had been appointed, and the organization at the Château Gif would allow of the development of animal and plant breeding together with pure research in genetics, cytology and biochemistry.

Prof. Mohr pointed out that with the limited organization available in Norway, special departments of genetics did not yet exist. He gave courses to medical students which were entirely voluntary but well attended, and appreciated by the students as providing the only training in scientific method which was available in the medical curriculum. Prof. Mohr deplored the death of his countryman, Christian Wriedt, one of the greatest of animal breeders, whose success depended on his genius for securing the help and understanding of the farmers themselves.

Prof. Sirks said that in all four universities of Holland there were chairs of genetics, while he had been in charge of the department of genetics at the Agricultural College of Wageningen before he went to the University of Groningen. The system allowed of the co-ordinated teaching of genetics to biological, medical and agricultural students.

The International Genetics Committee met during the Conference and decided to invite the co-operation

of Russian representatives as the first step to the organization of the Eighth International Congress, to take place, if possible, in 1947.

Conclusion

The Conference showed that, in spite of the War, decisive developments had occurred independently in the different countries represented. These developments were comprehensively summarized by Prof. Muller in his lecture, where he showed the primary importance of the concept of the gene in biology and more particularly in the application of physical and chemical methods to biology. It has, however, been on account of the War that a fuller use is now going to be made of this new genetics both in teaching and research in many different countries. A new epoch seems to be beginning in which biology will be treated as a whole.

DOCUMENTARY REPRODUCTION

By LUCIA MOHOLY

IT is becoming increasingly evident that documentary reproduction, the most popular group under the main heading mechanical aids to learning, is an invaluable help to men of science, educationists and other students. Among the various techniques available, preference has recently been given to microfilm as the quickest and cheapest method in all cases where one copy or a small number of copies are required. Another application of the micro-copying technique, the micro-card, is in preparation. It will be an addition, not an alternative, and does not affect the issues discussed here, since for the purpose of this article the relative merits of individual techniques are of secondary importance. However, we may expect to hear more of the micro-card in the near future.

It may be of interest to note that microfilm, after being invented more than seventy years ago, was completely forgotten, only to come into its own again when the need became imperative. In some countries, in particular the United States and Germany, microfilm was popular long before it became generally known in Great Britain. (One example may illustrate the extent to which it was used: before the War, 34 million cards in the U.S. Census Bureau, filed in 1,200 steel cabinets, occupying 7,000 sq. ft. of floor space, were microfilmed and thus reduced to occupy no more than 58 sq. ft.) Economy in storage space, bulk and weight, effected through microfilm, is now no longer unknown in Britain; nor are other purposes such as insurance against dangers of fire, water and enemy action. Precautions of this kind were taken everywhere and with great advantage during the War. Airgraph letters were one of the most outstanding examples of reduction in bulk and weight in air transport.

These obvious advantages, coupled with a few others of a less conspicuous kind, brought microfilm to the fore as a useful tool for purposes directly or indirectly connected with the war effort. Millions of documents were microfilmed in Britain and dispatched to distant places by air, and many millions of pages of varied literature, old and new, British and foreign, have been made available through the medium of microfilm to men of science and others all over the world. Large schemes have been sponsored by the American Council of Learned Societies (manuscripts and early books in British repositories, for the United States), the Association of Special Libraries and Information Bureaux (foreign periodicals for Great Britain and the United States) and the British Council (British periodicals for China). Government departments, research institutions and scholarly bodies equally recognized the importance of the technique; and though some of the schemes are now coming to an end, the practical experience gained during the war years will be invaluable for the future. It must be assumed that emergency conditions will prevail for some considerable time and microfilm may be called upon to fill needs which cannot be satisfied by other means. But while hitherto most of the work was carried out by bilateral arrangement between the parties concerned, the type and extent of work awaiting attention in the future will require co-ordinated action and well-planned organization.

Going through the Directory of Microfilm Sources, published by the American Library Association in 1941 (apart from a few exceptions still reasonably up to date so far as English-speaking countries are concerned—a new edition is in preparation), we find that most of the existing units which supply microfilm or other photographic reproductions for purposes of study and research were attached to, or sponsored by, scientific and other institutions, libraries, bibliographical centres, colleges, laboratories, research stations, archives, record offices, etc.

Generally speaking, the activities of the existing units cover a small range of the potential tasks now open to modern reproduction techniques. Their services have mostly been limited to the supply of microfilm or paper copies of periodicals otherwise unobtainable, or of extracts from books and periodicals needed in connexion with special lines of research. Some of the institutions give their services to members only, others to non-members also. The majority supply extracts from books and periodicals in their own libraries; a few only have established exchange and co-operation with other libraries and institutions, locate references, compile bibliographies, or issue abstracting journals to facilitate selection of subject-matter of which copies may be required. Examples of the latter group are: ASLIB Microfilm Service (London); Royal Society of Medicine (London); Institut de Documentation (Paris); Army Medical Library (Washington).

Many of us look upon documentary reproduction as a modern substitute for hand transcription. This is correct—up to a point; and it was generally correct—until quite recently. With the advent of the micro-copying technique, the potentialities of documentary reproduction have increased to an extent which was entirely unexpected until a few years ago, and they are now in the course of materializing into new instruments ready to perform a great number of new tasks.

Preliminary Programme of Tasks

1. Issue of limited editions which may not justify the cost of type-setting; for example, dissertations, theses, private editions. The cost of a microfilm negative is comparatively low and can easily be covered by a slight increase on the cost of each positive. From an existing master negative, copies can be supplied individually upon request. There is no need for a minimum number of copies to justify investment, since the investment is negligible.

2. Publication of scientific papers which cannot be accommodated in existing periodicals. A brief note or an abstract would direct the reader's attention to the fact that a paper is available in microfilm form. Particulars of author, title, cost and address of supplier if other than the publisher of the periodical would enable readers to order their own copies.

3. Reports of laboratory and field work to be circulated among small numbers of subscribers.

4. Data sheets, figures, formulæ, etc., to amplify papers or summaries published in periodicals. Particulars including cost, and address of supplier if other than the publisher of the periodical, would enable readers to order their own copies.

5. Re-publication of out-of-print books for which the demand is too small to justify new editions. A provisional agreement on the microfilming of books was issued as a Joint Memorandum of Publishers and Authors in consultation with ASLIB, and published in *The Bookseller* of July 27, 1944.

6. Re-stocking of libraries damaged or destroyed by enemy action, depleted by purging and looting under enemy occupation; or suffering from the consequences of war-time and post-war restrictions such as shortage of paper, transport, staff, etc.

7. Inter-library loans. The supply of microfilms would eliminate waiting for books which are out on loan as well as the necessity of urging their return. The cost for the library would not be substantially higher. Some administrators claim that it would be lower.

8. Reproduction of card catalogues or sections of card catalogues, not likely to be published in print. This measure would enable different departments in a library to have their own copies of the main catalogue, and other libraries to acquire copies of important catalogues of which the originals are not readily accessible.

9. Saving of storage space in libraries and archives. This applies in particular to books and papers kept for record purposes and not normally required for reference. The proportion of shelving space needed for the originals as against space for storing microfilm is in some cases as high as 100 : 1.

10. Reduction in bulk and weight allows increased use of air transport.

11. Preservation of the contents of valuable manuscripts, early books, newspapers and other written or printed documents threatened with disintegration through age or other causes.

12. Protection from deterioration through frequent handling. The life-time of a valuable document can be appreciably extended if the original is made accessible in rare instances only. Students will often find it quite satisfactory to consult films in lieu of originals.

13. Facilities open to scholars in all parts of the world for studying unique documents without undertaking long-distance travel.

14. Safeguard against destruction by fire, water, etc. To render this safety measure effective, film copies must be stored in a place away from the originals. (All film used for documentary purposes should be non-inflammable safety film.)

15. Distribution of research material to serve men of science and letters, students and research workers. Adequately organized, all-round co-operation in this field can develop a new type of service by combining scientific, scholarly and linguistic qualifications with bibliographical research and documentary reproduction. This new type of service, if centrally co-ordinated, might be a step towards the ultimate aim of keeping men of science and scholars currently informed of all the literature published on their respective subjects[1].

16. Analysis and reconstitution of existing publications, to provide dossiers of material relating to specific subjects. A great improvement on subject catalogues, press-cutting files and similar aids.

17. Supplements to bibliographical references not published with the paper or book, but available upon request. A note in a suitable place would direct the reader's attention to these supplements and give particulars, including cost and address of supplier if other than the publisher.

18. Educational activities and training schemes: (*a*) to relieve shortage of text-books and to supplement film strips; (*b*) as a help to children suffering from infantile paralysis (see item 20).

19. Re-education of children and adults in liberated countries. To relieve shortage of text-books and teaching staff and facilitate co-ordinated planning to direct and supervise educational activities.

20. Relief, rehabilitation and instruction for hospital patients, in particular war casualties and cases of infantile paralysis. Special apparatus for microfilm projection allows bedridden patients to read or study without help and at their own individual speed.

This list could be further extended, but must suffice for the present. Its main purpose is to demonstrate new categories of tasks and in particular direct attention to those which are bound to involve a number of interests from various quarters and can therefore only be planned and organized by co-ordinated effort.

Procedure and Users

Among the first and most important interests which should be invited to co-operate must be Government departments, libraries, bibliographical societies, information services, archives and records offices, library schools, learned institutions, scientific societies, research stations, educational authorities, universities, music academies, photographic societies, publishers of books and periodicals, authors, composers, abstractors, editors, and other professions. Their advice and assistance will be invaluable when programme and policy are being discussed, and contact with their opposite numbers in other countries will help to ascertain the extent to which co-operation can or must be international.

Not listed among the tasks awaiting attention, but equally important as a corollary to any large-scale planning is an accessory programme, including instruction courses (for personnel, librarians, students), information (to users and potential users), discussion meetings on questions of equipment, methods, economies (with colleagues, designers, manufacturers), and recommendations with the view of achieving world standards for machinery and material.

An important issue which will need renewed attention in the near future is the question of copyright. A provisional agreement has been reached on the microfilming of books[2]; and in so far as photographic reproduction is a substitute for hand transcription, it can be deemed covered by the amendment to the Copyright Act which grants fair use of copies needed for private study and research. If, as suggested, documentary reproduction is gradually transforming itself into a new instrument which can be put to a number of new uses, the copyright question will have to be reconsidered in a new light. In some

instances, royalties may be claimed and a modus will have to be found which is fair to all parties concerned. Obviously, the subject will need the co-operation of authors, publishers, learned societies and the legal profession in all countries[3].

Another point on which there is much difference of opinion is the question of payment. The alternatives under discussion are: (1) free service; (2) annual subscription; (3) payment for the job. An authority on microfilm and related subjects, Dr. Atherton Seidell, secretary of the Executive Committee of the Friends of the Army Medical Library, Washington, D.C., wrote in *Special Libraries* (October 1944): ". . . the final complete acceptance of microfilm copying as a legitimate function of library operation is at hand. Since no part of library operation is ever conducted as a business enterprise, it is very unfortunate that microfilm copying should have been so considered. There is no more justification for charging for limited microfilm copying than there is for charging for any of the other services by which the resources of libraries are placed at the disposal of those capable of using them for the advancement of learning". The stress is on the "limited copying"—but it is exactly here where opinions—and practices—vary considerably. It would be helpful if general agreement could be reached on the question as soon as possible. With regard to the more extensive programme now awaiting attention, different categories of documentary reproduction will require different treatment from the costing point of view; but any such details of financial policy should be worked out in close co-operation between all the interests concerned and any decisions on these matters should be adopted by universal agreement.

There can be no doubt that developments in matters of documentary reproduction—in particular so far as planning and policy for the future are concerned—have reached a stage when nothing short of co-ordinated effort can produce practical results.

When documentary services were in their early stages, it was essential for those who recognized their growing importance to keep in touch and exchange experiences. The annual conferences and publications of the International Federation of Documentation (frequently referred to by the initials of its French title as F.I.D.) were great and important events. The last of these international conferences before the War took place in Zurich in the summer of 1939. (The first post-war conference is planned for the spring or summer, 1946.) Since then, documentary reproduction has made itself indispensable, and questions of practical organization have become pressing. Exchange of experiences through international conferences is more important than ever; but beyond this we need machinery for permanent co-operation in day-to-day matters, effective co-ordination of policy, and general agreement on a scheme of international planning in documentary reproduction.

It will take some hard thinking to work out a procedure which will make international co-operation in these fields practicable. As a first contribution to further discussion, the following is a tentative suggestion:

1. Permanent offices should be set up in each and every country to act as centres of organized national systems of co-operating institutions in the field of documentary reproduction.

2. Permanent co-operation should be maintained between national offices of different countries with the view of setting up an international system of reproduction services and co-operating institutions agreed on questions of policy, procedure and economy.

3. An international system of co-operating institutions in the field of documentary reproduction would be in line with similar systems in other fields already functioning, or outlined for consideration and discussion, such as an International Science Co-operation Service[4]; an International Information Council[5]; an International System of Library Loans[6].

4. A permanent universal office should co-ordinate—under one central administration and guided by one agreed policy—the activities of all national and international centres, offices and systems of co-operating institutions in the field of documentary reproduction for purposes of study and research, science and learning, education and re-education in the post-war world.

[1] *Nature*, **155**, 26 (1945); *J. Documentation*, **1**, No. 1, 31 (1945).
[2] cf. Item 5, Preliminary Programme in Ref. 1.
[3] *Photographic J.*, **85B**, 92 (1945).
[4] *Nature*, **154**, 657 (1944); **156**, 401 (1945); **156**, 558 (1945).
[5] *Daily Sketch* (February 12 and 15, 1945).
[6] *The Times* (May 3, 1944).

THE SOLAR ECLIPSE OF 1945 AND RADIO WAVE PROPAGATION

By Dr. R. L. SMITH-ROSE
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IT has long been appreciated that an eclipse of the sun represents a unique opportunity of examining the effects of a temporary reduction or cessation of solar radiation on the ionosphere and the consequent effects on the propagation of radio waves. Observations of the influence of a solar eclipse on the reception of wireless signals have been made for more than thirty years past; and particular attention has been given to the use of radio wave-sounding technique to examine the changes brought about in the ionosphere by solar eclipses from 1927 onwards. The results of such previous investigations have shown quite definitely that ultra-violet radiation is the main cause of ionization of the lower layers of the ionosphere; but in the case of the upper region or F_2 layer, the results have usually been somewhat inconclusive. It has always been realized that swiftly moving neutral particles or corpuscles emitted by the sun could cause ionization in the upper regions of the atmosphere: because such particles travel much slower than light, there is an important difference in times of occurrence of what may be termed the 'optical eclipse' and 'particle eclipse' respectively. In consequence of the motions of the moon and the earth, the particle eclipse can occur from one to two hours in advance of the optical eclipse, the actual difference in time depending upon the velocity of the particles.

An additional series of measurements of the conditions affecting the transmission of radio waves through the ionosphere was carried out on the occasion of the solar eclipse of July 9, 1945, by the staff of the Radio Division of the National Physical Laboratory, working under the auspices of the Radio Research Board of the Department of Scientific and Industrial Research. These measurements were supplemented by a variety of other observations made by British Service establishments and other

organizations working to a general co-operative programme suggested and arranged by Sir Edward Appleton, secretary of the Department. The detailed analysis and study of the results obtained is in progress, but a preliminary and very brief account of the major effects observed can be given at this stage.

Ionospheric Soundings in Great Britain

The National Physical Laboratory scientific team on this occasion comprised Mr. R. Naismith and Dr. W. G. Beynon, who carried out ionospheric soundings at Burghead and Loth in Scotland; Mr. W. R. Piggott, who made similar measurements at Slough, England, where also some radio direction-finding observations were made by Mr. W. Ross; and Mr. L. H. Ford and Dr. B. G. Pressey, who conducted some ultra-short-wave field measurements at Teddington and Slough respectively.

The path of totality of the solar eclipse on this occasion was considerably to the north of the British Isles, and at the time of maximum phase, which was about 1400 G.M.T., the magnitude of the partial eclipse was 76 per cent at Loth and 61 per cent at Slough. At these stations the density of ionization in all three regions, E, F_1 and F_2, of the ionosphere was reduced by amounts of 30–45 per cent during the optical eclipse, the reduction being greater in the F_2 than in the E region. A decrease in ionization which occurred during the morning on the day of the eclipse may be associated with a corpuscular eclipse.

Absorption of Radio Waves in the Ionosphere

Observations were also made at the above stations of the amount of absorption to which the radio waves were subject at vertical incidence reflexion. These were carried out on a number of selected frequencies and, as in the case of all the other measurements, over a period of seven days centred on July 9. The observations of most interest are those made on frequencies less than the minimum value reached by the critical frequency of the normal E region during the eclipse period; for on these frequencies the absorption measurements are not complicated by the marked changes in signal intensity associated with the critical frequency phenomena, and any variations which may occur can be attributed to changes in the absorbing layer of the ionosphere.

The changes in absorption observed at Slough during the eclipse period were less marked and of shorter duration than those at Loth, a result to be expected from the greater obscuration of the solar disk at the latter place. Thus on a frequency of 2 Mc./s. the ionospheric absorption at Slough decreased by about 1 neper (8·7 db.) for a period of about forty minutes near the time of maximum totality. At Loth, on the same frequency, the decrease amounted to 1·3 nepers (11·3 db.); in this case, the absorption reached its minimum value at about the period of maximum phase, and remained below the average midday value throughout the period of the optical eclipse. Similar results were observed on other frequencies.

The measurements at Loth on all frequencies showed that the period of maximum absorption coincided reasonably well with the time of maximum optical eclipse. The magnitude of the decrease in absorption was also of the order to be expected from theoretical considerations on the assumption that the ionization of the absorbing D region is produced by ultra-violet radiation from the sun.

Effect of Eclipse on Communication

The above measurements made under vertical incidence conditions were supplemented by observations of the received signal strength of ordinary communication and broadcasting transmissions carried out by the staff of the Post Office and British Broadcasting Corporation. Full reports of these will be available later, but a few typical results may be quoted here.

During the eclipse period, observations on trans-Atlantic transmissions on a frequency of 18 kc./s. and 58·5 kc./s. showed no appreciable change; but on a frequency of 216 kc./s. transmitted over a 1,260 km. path, a slight increase in field-strength was noted. In the medium wave-length broadcasting band, the field-strength in the north of Scotland on transmissions from Droitwich on a frequency of 1·15 Mc./s. showed a sharp increase of some 5 db. at about forty-five minutes after the commencement of the optical eclipse. The intensity of the received signal reached a maximum near the time of maximum phase of the eclipse, after which conditions gradually returned to normal. These results, obtained during transmissions through the ionosphere at oblique incidence, show that during the optical eclipse there was a small, but definite, decrease in ionospheric absorption for various frequencies in the band 60 kc./s. to 1 Mc./s.

Direction Finding

An extensive series of radio direction-finding observations was carried out at the Radio Research Station, Slough, during the eclipse, on transmissions from stations in America, U.S.S.R., India, China and Spain, using frequencies between 10 and 15 Mc./s. A rotating spaced-loop direction-finder of high accuracy was used, but the results obtained on the day of the eclipse did not differ significantly from those observed on other days before and afterwards. In most cases the deviations in bearings were less than 1°, the highest being 1·6°; and the results in general illustrate the very high accuracy which is obtainable in radio direction finding over long distances—1,300–8,500 km.—in favourable circumstances.

Transmissions on Ultra-Short Waves

In addition to the above work, the opportunity was also taken to examine any effects produced by the eclipse on the transmission of waves of much higher frequencies than those referred to above. By arrangement with the British Broadcasting Corporation, a programme of transmissions was provided from Alexandra Palace station on a frequency of 46·3 Mc./s., and the field received at both Teddington and Slough, some twenty-five miles distant, was recorded continuously for more than thirty hours including the eclipse period. No significant effects due to the obscuration of the sun were observed, and the received signal was sensibly constant to better than 1 db. for the whole period of the measurements. Similar results were obtained on a frequency of 92 Mc./s. during measurements of the field strength received at Slough from a transmitter at Teddington, eleven miles away.

Observations Received from the U.S.S.R.

A brief summary has been received by telegram of some of the results obtained during the eclipse by workers at the Mandelstamm Laboratory of Oscillations as part of the Physical Institute of the

Academy of Science of the U.S.S.R. This Laboratory is under the direction of Dr. Papalexi, a member of the Academy, and the results have been communicated by Mr. J. N. Alpert, who made the measurements in co-operation with Mr. N. Gorozhankin.

The radio observations were carried out in the vicinity of Moscow, where the optical eclipse in the ionosphere was total; and the results confirmed the hypothesis that the ionization in the *E* region is mainly caused by ultra-violet radiation from the sun, and thus supported previous conclusions that in medium latitudes, the emission of particles from the sun is not the chief cause of ionization in the ionosphere. The communication from Moscow states, however, that some characteristic variations in ionization occurred several hours before the optical eclipse, and at about the time that a particle eclipse would take place if the particles from the sun were travelling with speeds of 450–600 km. per sec. These variations were not observed on the days before and after July 9, the day of the solar eclipse.

OBITUARIES

Dr. J. F. Tocher

James Fowler Tocher, born in 1864 at Fyvie in Aberdeenshire, was a man of many interests: by profession a pharmaceutical and analytical chemist, he found time in a busy life to make numerous contributions to the history, antiquities and anthropology of his native country, and he was most successful in stimulating popular regard for all branches of local knowledge.

His story indicates something of the drive and resolution that lay behind his genial presence. He left school early and, having served an apprenticeship in a country chemist and druggist's shop, he set up on his own account a similar business in Peterhead. But his energies were bent on finding a scientific outlet beyond the dispensing room, and in 1887 he founded the Buchan Field Club, which became a focus for local lore, and the *Transactions* of which, with two elaborate volumes "The Book of Buchan" (1910 and 1943) both of which Tocher edited, form an invaluable compendium of the history and natural history of the north-east of Scotland.

Later Tocher's interest in statistical analysis, encouraged by Karl Pearson, led him to plan and carry out with Dr. John Gray an extensive survey of the physical characteristics of Scottish school children and adults. More than half a million individuals were examined, and the results, published in the *Journal of the Anthropological Institute* and *Biometrika* from 1908 onwards, brought out many new facts about the distribution of ethnological groups. Thus the north-east of Scotland was found to be the home of a population characterized by a higher proportion of red-haired and a lower proportion of dark-eyed individuals than any other part of the country; and the centres of population were shown to have relatively more dark-eyed and dark-haired people than the country districts.

While the survey was in progress, Tocher determined to study for a B.Sc. degree at the University of Aberdeen, and this enthusiast of forty years, under great handicaps, completed the course and graduated in 1908. A few years later his investigations won him the degree of D.Sc.

In 1911 he was appointed lecturer in statistics in the University of Aberdeen, and thereupon transferred his home to that city and took up appointments as agricultural analyst for Aberdeenshire and other counties in the north of Scotland, and consulting chemist to the Highland and Agricultural Society. He served on the governing bodies of most of the teaching and research institutes in Aberdeen, and in 1909 was president of the British Pharmaceutical Conference. Recently he received from his University its LL.D.

Dr. Tocher had a great gift of friendship, and his overflowing spirits expressed themselves in goodwill and effervescent humour, whether on the more formal occasions of a Burns' Club address, or in the anecdotes of a casual gathering. He died in Aberdeen on November 8, aged eighty-one. James Ritchie.

Mr. B. B. Bancroft

B. B. Bancroft, who was killed while serving as a 'seaborne aircraft identifier' during the invasion of Normandy on June 24, 1944, will long be remembered for his work on the trinucleids and brachiopods of the Shropshire Ordovician, upon which four of his papers appeared in the *Memoirs* of the Manchester Literary and Philosophical Society for the years 1928 and 1929. He was the first geologist to recognize the unconformity at the base of the Ashgillian near Bala, and made many advances in the stratigraphical correlation of English and Welsh Ordovician sections. One of his greatest successes lay in his discrimination between *Heterorthis retrorsistria* and *H. alternata* and his assignment of them to their correct stratigraphical horizons. Some of his best work was privately printed in "Correlation Tables of the Stages Costonian-Onnian in England and Wales" (1933), and his "Brachiopod Zonal Indices of the Stages Costonian to Onnian in Britain" has recently appeared posthumously in the *Journal of Paleontology* in the United States. It is hoped other papers will follow.

Bancroft served also in the War of 1914–18, in the Royal Garrison Artillery, and was recommended for the Croix de Guerre. It was typical of his fearless spirit that in the recent War, though well advanced into middle age and a member of a reserved profession, he should again be a volunteer. One who was with him in the attack on the "West Wall" writes:

"It was a very great experience and lesson to me to live for a time with a man of such age and experience as he, to whom anything but complete truth was abhorrent. He had the mind and outlook of a true scientist." Archie Lamont.

We regret to announce the following deaths:

Mr. R. H. Briggs, M.B.E., editor of the *Overseas Engineer* and recently assistant director of the Technical Press Censorship, Ministry of Information, on January 3, aged fifty-eight.

Prof. Charles Fabry, For.Mem.R.S., until recently president of the International Council of Scientific Unions, on December 11, aged seventy-eight.

Prof. E. S. Goodrich, emeritus professor of zoology and comparative anatomy in the University of Oxford, on January 6, aged seventy-seven.

Prof. T. H. Morgan, For.Mem.R.S., professor of biology and director of the Wm. G. Kerchhoff Laboratories, California Institute of Technology, since 1928, on December 4, aged seventy-nine.

NEWS and VIEWS

U.S. Committee on Atomic Energy Safeguards

MR. BYRNES, U.S. Secretary of State, has announced the appointment of the following committee to study the problems of controls and safeguards in connexion with the utilization of atomic energy and the United Nations Organisation: Mr. Dean Acheson, Under-Secretary of State (chairman), Mr. John J. McCloy, a former Assistant Secretary for War, Dr. Vannevar Bush, director of the Office of Scientific Research and Development, Dr. James B. Conant, chairman of the National Defense Research Committee and president of Harvard University, and Major-General Leslie R. Groves.

Aerodynamics at the National Physical Laboratory: Mr. A. Fage, F.R.S.

MR. A. FAGE, a principal scientific officer of the Aerodynamics Division of the National Physical Laboratory, has been appointed superintendent of the Division in succession to Mr. E. F. Relf, who has held this post for the last twenty years. Mr. Fage began his career in Portsmouth Dockyard, won a scholarship to the Royal College of Science where he obtained his associateship and the diploma of the Imperial College, and then joined the staff of the National Physical Laboratory. It is interesting to note that his early career is thus almost identical with that of his predecessor. In his early days at the Laboratory, he took part in most kinds of aerodynamic work, but later he specialized in research on airscrews and was soon recognized as an authority on this subject. He then took up fundamental work on fluid motion, and it is in this subject that he has established an international reputation. Among many original investigations may be mentioned his detailed study of the flow around an aerofoil of finite aspect ratio and his masterly experiments on the distribution of skin friction along the chord of an aerofoil, which provided a basis for the understanding of aerofoil drag that is still of great value and appears to be unique in experimental aerodynamics. His adaptation of the principle of the ultramicroscope to the study of turbulent airflow provides another striking example of his versatility and skill as an experimenter. In a number of lesser investigations Mr. Fage has contributed notably to aerodynamic knowledge; among these may be mentioned his study of the effect of turbulence on the reading of a static pressure tube, and his critical analysis of the use of flight-test observations to determine engine-power at great altitudes.

Much of Mr. Fage's best work has been published by the Royal Society, and he was elected to the fellowship in 1942. His most recent work has again been upon fluid flow problems, but much of it is as yet unpublished on account of its relation to matters still regarded as secret. It is to be hoped that this restriction will soon be removed, as there is no doubt that Mr. Fage's reputation as one of the leading British research workers in aerodynamics will be considerably enhanced thereby. In particular, he has much to contribute to the problems of compressible flow and shock waves. In taking over the post of superintendent of the Aerodynamics Division of the National Physical Laboratory, Mr. Fage will naturally find less time for independent research, but it is to be hoped that he will still be able to contribute to fundamental knowledge of aerodynamic problems, as he has done so brilliantly in the past.

Botany in New Zealand: Dr. V. J. Chapman

DR. V. J. CHAPMAN, university demonstrator in botany, Cambridge, has been appointed professor of botany in Auckland University College, New Zealand. For one specially interested in all aspects of maritime ecology, including seaweeds, no place more suitable than Auckland could be selected. He is also interested in forest ecology, and a most promising field of investigation awaits him in the kauri forest reserves in the far north of the island. On graduating at Cambridge in 1932, Dr. Chapman was appointed Frank Smart student at Gonville and Caius College and began comprehensive researches on the salt marshes of the Norfolk coast, afterwards publishing several papers on their ecology. During 1935–36 he held a Henry fellowship at Harvard University and continued his investigations on salt marshes in a different environment. While in America he spent some time on the Pacific coast, which further stimulated his interest in seaweeds. On returning to England he held an assistant lectureship in the University of Manchester but soon migrated back to Cambridge on election to a fellowship at his College and appointment to a demonstratorship. During 1939 he organized and led the Cambridge University botanical expedition to Jamaica, where he studied the coastal mangrove formations. In 1942 he conducted a survey of the larger seaweeds around the British coasts for the Ministry of Supply, some of which were afterwards exploited for war purposes. Early in 1945 he was appointed botanical specialist in operational research at the headquarters of South-East Asia Command, from which he has recently returned. New Zealand, which is a botanist's paradise, is fortunate in securing the services of such an enthusiastic worker in fields of research particularly appropriate to the Dominion, and Dr. Chapman is fortunate in his opportunity.

Mr. C. E. Rickard, O.B.E.

MR. C. E. RICKARD, who joined Marconi on August 2, 1898, as technical assistant, has retired from the position of general manager of the Marconi Co. Mr. Rickard has been a well-known figure in wireless circles and he will be greatly missed from the day-to-day affairs of wireless administration. He was intimately concerned in all the early experimental work and demonstrations given by the Marconi Co. to the British and to foreign Governments. After returning in 1919 from war service, for which he was awarded the O.B.E., he became assistant to Mr. Andrew Gray, engineer-in-chief of the Marconi Co., and held successively the posts of deputy engineer-in-chief, engineer-in-chief, technical general manager and acting deputy managing director. He retired in 1939, but returned a year later to help with the war effort as general manager of the Company. In addition to the work he has done in connexion with the construction of wireless stations and the development of wireless services in all parts of the world, Mr. Rickard served on many Post Office committees and international conferences on wireless matters. In 1930 he acted as adviser on radio matters to the Russian Government and in the same year was elected chairman of the Radio Section of the Institution of Electrical Engineers.

Conference on Metallic 'Creep'

THE subject of creep and flow of metals at high temperature has become of increasing importance in view of the new methods of propulsion and the need for high-duty alloys which have arisen in the war years. At the same time, the pressure and urgency of the war-time problems have tended to concentrate research resources on the quick determination of experimental data and thus to restrict the time and attention which might have been devoted to the theoretical aspects of the subject. In an endeavour to offset this trend, and to obtain as much information and as wide a view as possible on the direction into which research on this subject should be guided, an all-day conference on metallic creep is being arranged, which is to be held at the Royal Society, on February 5. The programme opens with an introduction and a history of the subject by Prof. E. N. da C. Andrade. Other papers will deal with experimental studies of creep (H. J. Tapsell), physical theory (E. Orowan), metallurgical control of creep (Dr. N. Allen). The meeting will close with a general discussion, to be introduced by Sir Lawrence Bragg. It is hoped that, as a result of the conference, it will be possible to devise appropriate research projects and to share them between the various laboratories interested in 'creep', under a scheme which will provide close and effective inter-laboratory liaison. Attendance at the conference is by invitation only; applications to attend should be addressed to Sir Charles Darwin, at the National Physical Laboratory, Teddington, Middlesex.

Central Medical Library Bureau

THE Rockefeller Foundation has made an appropriation to the Royal Society of Medicine of a sum not exceeding £61,725, for capital expenditure and tapering maintenance over four years, to enable the Society to establish a Central Medical Library Bureau. The immediate function of this organisation is to assist in the rehabilitation of medical libraries on the Continent which have suffered through deprivation or devastation, and its long-term function the exchange of scientific medical information between individuals and institutions. The method to be employed initially is the use of microfilm; but microfilm will only be supplied so long as the Society is satisfied that journals needed are unobtainable in their original form. A number of the best microfilm readers obtainable will be purchased by the Society and lent to participating institutions. The scheme approved by the Rockefeller Foundation envisages that while the work of rehabilitation is being carried on, interchange of information between medical libraries will be developed into a permanently functioning scheme which can continue to operate when rehabilitation is completed. Thus the more permanent function of the Central Medical Library Bureau will be gradually established, and the subscriptions of individuals and of associated libraries should enable the Society to continue the service without further assistance from the Rockefeller Foundation.

French Psychologists During the War

THE secretary of the British Psychological Society, Prof. D. W. Harding, has received letters from two honorary fellows of the Society in France, from which the following extracts will be of interest. Prof. P. Janet writes: "Je vous remercie vivement de votre bonne lettre et je vous prie de remercier de ma part mes collègues de la société pour l'intérêt qu'ils veulent bien prendre à ma santé et à mon pauvre pays. Malgré bien des tristes deuils dans ma famille je me porte bien à 86 ans et je puis encore assez bien travailler." Prof. Georges Dumas writes: "Je n'ai pas souffert dans ma santé pendant ces six années d'épreuves mais je n'en ai pas moins 80 ans. Je n'ai pas besoin de vous dire avec quel sentiment de reconnaissance nous pensons tous à nos amis anglais qui nous ont si puissament aidés à nous sauver du plus grand danger qui ait menacé la France depuis le commencement de son histoire."

Announcements

A MEMORIAL service for the late Dr. E. F. Armstrong, who died on December 14, will be held on Thursday, January 17, at 2.30 p.m. at St. Martin's-in-the-Fields.

SIR I. M. HEILBRON, professor of organic chemistry at the Imperial College of Science and Technology, London, has been awarded the Priestley Medal of the American Chemical Society, the highest honour in the Society's gift, which is awarded every three years for distinguished services to chemistry.

DR. W. J. S. NAUNTON, of Imperial Chemical Industries, Ltd., has been awarded the Colwyn Gold Medal of the Institution of the Rubber Industry for conspicuous services rendered to the rubber industry.

THE Council of the Geologists' Association has accepted a sum of money for the establishment of a fund to commemorate Henry Stopes, a pioneer in investigations concerning early man. The Fund, which is to be known as the Henry Stopes Memorial Fund, will provide for the triennial award of a bronze medal for work on the prehistory of man and his geological environment. The design and execution of the medal has been entrusted to Mr. E. R. Bevan.

A David Anderson-Berry Silver-gilt Medal, together with a sum of money amounting to about £100, will be awarded in 1947 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the therapeutical effect of X-rays on human diseases. Applications for this prize, which may be based on both published and unpublished work and should be accompanied by copies of relevant papers, must be in the hands of the General Secretary, Royal Society of Edinburgh, 22 George Street, Edinburgh 2, by December 1, 1946.

A JOINT Committee on Metallurgical Education has been formed by the Councils of the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of British Foundrymen, the Institute of Metals and Institution of Metallurgists. The Committee will advise and co-ordinate the policy of these Councils on all matters concerning education in metallurgy, direct attention to the requirements of industry, advise those responsible for teaching and assist parents and masters in guiding boys in the choice of future careers. Inquiries should be addressed to the Secretary at 4, Grosvenor Gardens, London, S.W.1.

ERRATUM. In *Nature* of January 5, p. 6, the second reaction in column 1 is of course incorrect; it should read:

$$^{239}_{94}Pu \rightarrow {}^{235}_{92}U + {}^{4}_{2}He + \text{energy}.$$

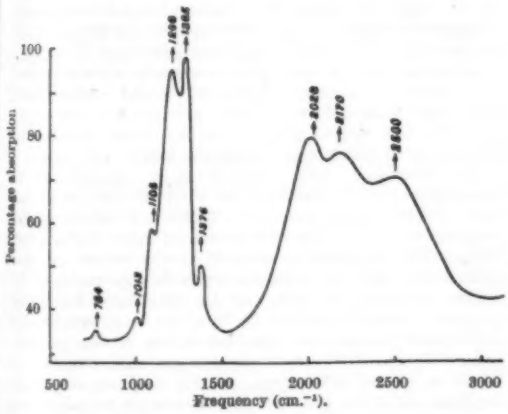
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Infra-Red Absorption Spectrum of Diamond

In the recent Faraday Society discussion on infra-red spectroscopy reported in *Nature* of February 17, 1945, certain comments were made on the work done at this Institute on diamond. The full report of the discussion is now in our hands, and we wish to point out that, contrary to what was stated at the meeting, the experimental data presented by Dr. Sutherland and Mr. Willis[1] are in full accord with what should be expected on the basis of the ideas regarding the structure of diamond and the nature of its lattice spectrum published from this Institute[2,3].

If diamond has octahedral symmetry of structure, none of the lattice vibrations could, in the first approximation, appear in infra-red absorption. In the second approximation, when anharmonicity is considered, they would be allowed as octaves and may also appear as combinations. On the other hand, if the structure is tetrahedral, the Raman-active frequency of 1,332 cm.$^{-1}$ would be active as a fundamental in the infra-red absorption, while all the other lattice vibrations would, in the first approximation, be inactive. In the second approximation they would, as in the case of octahedral symmetry, be allowed as octaves and may also appear as combinations. The first-order activity of the 1,332 vibration would also result in all the other lattice frequencies in its vicinity being rendered infra-red active as fundamentals to varying extents.



Reproduced herewith is one of the absorption curves of Sutherland and Willis carefully redrawn on a uniform frequency scale. The peaks marked as 2,500, 2,170 and 2,028, when examined under adequate resolving powers, appear extremely sharp[4], and their frequencies coincide with the octaves of the fundamental frequencies of diamond at 1,250, 1,088 and 1,013 cm.$^{-1}$ revealed by the investigations made at this Institute on the luminescence spectrum and the second-order Raman effect. A striking feature of the experimental data is the precipitous fall of the absorption strength between 1,285 and 1,376 cm.$^{-1}$. The centre of this fall coincides exactly with the Raman frequency 1,332 cm.$^{-1}$. A similar precipitous fall of intensity appears at the corresponding positions in the second-order Raman spectrum and in the luminescence spectrum, and there can be no doubt, therefore, that the absorption band arises from the activity of the 1,332 vibration and is the joint effect of this and the three other fundamental vibrations close to it in frequency which are rendered active by its influence. The correctness of this view is demonstrated by the appearance of a feeble peak at the fundamental frequency 1,013, while the more prominent peak at 1,105 undoubtedly represents the fundamental frequency 1,088 which appears slightly shifted as a result of the steepness of the absorption curve at this point.

We desire also to emphasize two major points which appear to have been overlooked in the discussion. That diamond may be either tetrahedral or octahedral in symmetry is not an *ad hoc* hypothesis. One has only to study the extensive crystallographic literature on diamond and the reports of experienced observers who have had access to suitable material to appreciate the position in this respect correctly. Further, it is an indisputable fact[5] that the diamonds which show the infra-red absorption in the 8 μ region are precisely those which make the nearest approach to ideal crystal perfection, while the diamonds which do not show this absorption band exhibit characteristic irregularities of structure. Hence, the appearance of the absorption band and its absence respectively in the two cases cannot be ascribed to crystal imperfections or other adventitious circumstances, and must be due to a fundamental difference in crystal symmetry.

R. S. Krishnan.
K. G. Ramanathan.

Physics Department,
Indian Institute of Science,
Bangalore. July 7.

[1] Sutherland and Willis, *Trans. Faraday Soc.*, **41**, 281 (1945).
[2] Raman, C. V., *Proc. Ind. Acad. Sci.*, A., **19**, 189 (1944).
[3] Raman, C. V., *Proc. Ind. Acad. Sci.*, A, **18**, 237 (1943).
[4] Robertson, Fox and Martin, *Proc. Roy. Soc.*, A, **157**, 579 (1936).
[5] Raman, C. V., *Current Science*, **12**, 33 (1943).

One of the crucial arguments put forward by Raman in support of 'tetrahedral' and 'octahedral' diamonds being associated with the Type I and Type II diamonds of Robertson, and Fox and Martin, was that the tetrahedral form should have a certain fundamental vibration frequency active in infra-red absorption and also in scattering, while for the octahedral form this same frequency should be inactive in absorption. Raman identified this frequency with the well-known scattering line at 1,332 cm.$^{-1}$ and claimed that this frequency coincided with the infra-red absorption "between 1350 and 1300 cm.$^{-1}$" on Type I diamonds. One of the purposes of the paper by Willis and myself was to point out that this last was a serious mis-statement of fact, since the principal infra-red absorption maxima in this region of the spectrum lie at 1,286 cm.$^{-1}$ and 1,376 cm.$^{-1}$, of which the former is much more intense than the latter.

Krishnan and Ramanathan now propose to evade this awkward fact by considering the infra-red frequency to be defined by the *position of minimum absorption* between the above-mentioned two bands. Why is this particular minimum singled out for preferential treatment? In all the other identifications Krishnan and Ramanathan make, they choose the *maximum of absorption* to define the infra-red

frequency. It cannot be too strongly emphasized that Krishnan and Ramanathan give no justification whatever for their assumption. Their vague statement that the structure of the infra-red spectrum in the region 1,200–1,400 cm.$^{-1}$. is "the joint effect of [the 1332 cm.$^{-1}$ frequency] . . . and the three other fundamentals" (presumably those proposed at 1,149, 1,248 and 1,284 cm.$^{-1}$) does not resolve the difficulty, but only adds to the confusion. This statement can only mean that there is some interaction between the four modes of vibration associated with these frequencies which causes displacement of the levels in the case of infra-red absorption but not in the case of Raman scattering! It would be interesting to see the energy-level diagram (with absorption and scattering transitions indicated) by which Krishnan and Ramanathan would support their interpretation of the vibration spectra of Type I and Type II diamonds.

Krishnan and Ramanathan's statement that the correctness of their view is demonstrated by their identification of two absorption *maxima* at 1,013 cm.$^{-1}$ and 1,088 cm.$^{-1}$ is a complete *non sequitur*. What they should have found at these positions to demonstrate their point were absorption minima! It is indeed the case that there are certain coincidences between the infra-red maxima and the list of fundamentals proposed by the Indian school, but there are also several infra-red maxima which cannot be explained in terms of their proposed fundamentals.

G. B. B. M. Sutherland.
Laboratory of Colloid Science,
Cambridge. Oct. 1.

Electronic Spectra of Polyatomic Molecules. Vibrations of the $^1B_{2u}$-State of Benzene

The methods of interpreting the rotational, vibrational and electronic spectra of diatomic molecules, and the rotational and vibrational spectra of polyatomic molecules, are well established; but the electronic spectroscopy of polyatomic molecules is still in a relatively undeveloped state. Consequently the first use, within the last-named field, of potentially important working-tools seems worth recording.

Two methods have been much used in the vibrational analysis of the vibration-rotation spectra of polyatomic molecules in their electronic ground-states, namely, (1) comparison of observed isotopic effects on fundamental frequencies with the requirements of the Teller-Redlich product theorem, and (2) the approximate location of particular fundamental frequencies by calculations based on simplified potential systems. There is no reason of principle why either of these methods should not be applied to any electronically excited state which is stable enough to exhibit vibrational levels. We here exemplify both methods in relation to the near ultra-violet electronic transition of benzene.

Sklar first recognized the character ($^1B_{2u}$) of the excited state concerned in this transition, and, with Sponer, Nordheim and Teller, showed how the salient features of the relevant band systems in fluorescence and absorption spectra could thus be interpreted[1]. The regular pattern of stronger bands was found to depend overwhelmingly on two vibrations, the lower E_g^+(C) vibration, with the allowed quantum change $\Delta v = \pm 1$, and the totally symmetrical vibration A_{1g}(C), with quantum changes limited only by Boltzmann factors and the Franck–Condon principle. We have tried to carry this analysis further. The experimental material[2] consists of the weaker bands of the appropriate spectra: though weak, these bands are potentially the chief source of information about the vibrations of the upper electronic state.

The weak frequencies occurring in these spectra include, *inter alia*, (i) first overtones, $2\nu'_n$, of non-totally symmetrical vibrations in the excited electronic state ($\Delta v = 2$), and (ii) difference frequencies, $\nu''_n - \nu'_n$, of the same vibration, n, in the lower ($''$) and upper ($'$) electronic states ($\Delta v = 0$). A frequency of either type having been observed, an identification of the vibration, n, to which it belongs yields directly the fundamental frequency, ν'_n, of that vibration in the electronically excited molecule. This is true for an observed difference frequency because all the twenty vibrational frequencies, ν''_n, of the ground electronic state of benzene are known[3].

The frequencies $2\nu'_n$ appear with positive signs, and the frequencies $\nu''_n - \nu'_n$ with negative signs, in the empirical frequency formulæ. When a frequency of either type occurs without an associated quantum change in an E_g^+ vibration, the selection rules enable one to assert that the vibration n is degenerate. Occurrences and intensities generally are governed by Boltzmann factors and transition probabilities as limited by the Herzberg–Teller extension of the Franck–Condon principle.

Within this framework, vibrations n can be identified, and their upper-state frequencies ν'_n determined, in three ways. (1) If $2\nu'_n$ and $\nu''_n - \nu'_n$ are both observed for the same n, the selection of ν''_n to give a consistent ν'_n will identify n. (2) Values of ν'_n, determined by (1), or hypothetically assumed, for isotopic molecules such as C_6H_6 and C_6D_6, must satisfy the product theorem; confirmation may thus be obtained, or the product theorem may be used to calculate a frequency ν'_n if sufficient related frequencies are known. (3) Values of ν'_n, determined by (1) or (2), or assumed, should agree approximately with calculations based on a simplified force system; confirmation may thus follow, or the calculations may be used for the approximate location of an unknown frequency of the upper electronic state.

We illustrate these procedures by means of a determination of five (and an approximate calculation of the remaining one) of the six out-of-plane frequencies of the excited states of both C_6H_6 and C_6D_6. The frequencies (cm.$^{-1}$) listed below as observed are derived from the spectra (by method 1, unless otherwise stated), and are confirmed by their product ratios (method 2), and by approximately calculated frequencies (method 3), as shown in the table. We use Bell's two-constant potential function[4], which is known to be capable of giving out-of-plane frequencies of the ground-state to within 10 per cent, and is evidently not less successful in its application to the excited state.

n	$\nu'_n(C_6H_6)$		$\nu'_n(C_6D_6)$		Product ratio	
	Obs.	Calc.	Obs.	Calc.	Found	Calc.
A_{2u}	515	478	382	351	1·343	1·362
B_{2g}(C)	364*	387	307	328	—	1·414
B_{2g}(H)	—	774	—	637		
E_g^-	586	585	454	(454)**	1·290	1·289
E_{2g}^+(C)	242	238	208	(208)**	1·401	1·414
E_{2g}^+(H)	708	720	588	588		

* Only $2\nu'_n$ has been observed: the calculations guide its assignment.

** These two frequencies were used to determine the force constants.

The out-of-plane vibrations are notable for their greatly diminished frequencies in the excited state as compared with the ground-state. The reductions, shown below, clearly mirror that weakening of the plane-retaining forces due to the unsaturation electrons, which results from the lifting of one such electron into a higher orbital: in terms of Bell's representation of the force system, the hydrogen force constant becomes approximately halved, and the carbon force constant reduced to about one third of its value, in consequence of the excitation.

C_2H_2	ν''_n(cm.$^{-1}$)	671	703	985	849	405	970
	ν'_n(cm.$^{-1}$)	513	364	~774	586	242	708
	% Drop	24	48	~21	31	40	27
C_2D_2	ν''_n (cm.$^{-1}$)	496	601	827	662	352	793
	ν'_n (cm.$^{-1}$)	382	307	~637	454	208	585
	% Drop	23	49	~23	31	41	26

No general discussion of the in-plane vibrations can be included in this note; but it may be remarked that an assignment already suggested of the frequencies 2565 cm.$^{-1}$ of C_2H_2 and 1821 cm.$^{-1}$ (or a weaker neighbouring frequency) of C_2D_2 to the upper state A_{1g}(H) vibration is shown by the product theorem to be at least partly incorrect, since, in combination with the known frequencies, 923 cm.$^{-1}$ of C_2H_2 and 879 cm.$^{-1}$ of C_2D_2, of the upper state A_{1g}(C) vibration, they lead to a quite unacceptable value of the upper state A_{1g} product ratio.

A fuller consideration of all these matters will be published elsewhere.

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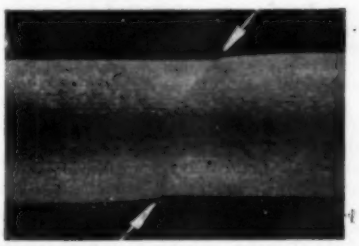
Oct. 19.

[1] *J. Chem. Phys.*, **5**, 669 (1937); **7**, 207 (1939).
[2] Ingold and Wilson, *J. Chem. Soc.*, 941 (1936). Wilson, *J. Chem. Soc.*, 1210 (1936). Radle and Beck, *J. Chem. Phys.*, **8**, 507 (1940). Sponer, *J. Chem. Phys.*, 705 (1940).
[3] *J. Chem. Soc.* (In the press).
[4] *Trans. Faraday Soc.*, **41**, 293 (1945).

Lattice Distortions and Shear in Aluminium Single Crystals

Deformation experiments have been carried out with aluminium single crystals by means of a specially constructed apparatus (Bausch apparatus[1]), which approximates a pure shear (the applied stress being parallel to the glide plane (111) and to the glide direction [110]). Fig. 1 is a reproduction of a photograph of a sheared crystal. The experiments have shown that even such a deformation process causes an asterism of the Laue interference spots, pointing to the presence of locally curved lattice regions, the direction of curvature being perpendicular to the direction of gliding.



Aluminium single crystal after a shear 0·4 × 10.

It is suggested that the absence of asterism shown by naphthalene crystals subjected to the same process, as observed by Kochendörfer[2], is due to the fact that in this crystal the number of active glide planes is much larger than in aluminium (the width of the glide lamellæ being thus correspondingly smaller), so that the number of arrested dislocations along each individual active glide plane is much smaller and thus the resulting curvature much weaker.

From our experiments we infer that shear hardening is not necessarily accompanied by a curvature of the glide planes of sufficient magnitude to give rise to Laue asterism. It may be caused both by a large number of 'individually' arrested dislocations (causing only slight curvatures of the lattice) and by a small number of 'groups' of arrested dislocations (causing much larger curvatures of the glide planes).

Crystals were also sheared in directions differing from the combination (111) [110], known from extension and compression experiments. In all these cases a Laue asterism, similar in character to that mentioned above, was observed. Moreover, the shear stress-shear curves coincided for all the orientations investigated, at least within the limits of accuracy attained. They resemble closely the stress-strain curves obtained by Taylor[3] and by Karnop and Sachs[4] in extension and compression experiments with aluminium single crystals.

On the ground of the experimental evidence, arguments can be given in favour of the view that in aluminium gliding may be *forced* along lattice planes and directions differing from the combination (111) [110], for values of shear stress which do not vary considerably for different glide combinations.

The experimental fact that no broadening of the Debye-Scherrer interference lines is observed in heavily deformed (rolled or drawn) aluminium may be connected with this behaviour.

Details will be given in a forthcoming paper in *Rec. Trav. Chim. Pays-Bas.*

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Delft. Aug. 22.

[1] Bausch, K., *Z. Phys.*, **96**, 479 (1935).
[2] Kochendörfer, A., "Plastische Eigenschaften von Kristallen und metallischen Werkstoffen" (Berlin, 1941), 11 *et seq.*
[3] Taylor, G. I., *Proc. Roy. Soc.*, A, **116**, 39 (1927).
[4] Karnop, R., and Sachs, G., *Z. Phys.*, **41**, 116 (1927).

Solar Radiations in the 4-6 Metre Radio Wave-Length Band

The solar radiation spectrum does not normally extend into the 5-metre wave-length region with sufficient intensity to be detectable on radio receiving equipments in commercial or Service use. It is now possible to disclose that, on one occasion during the War, Army equipments observed solar radiations of the order of 10^5 times the power expected from the sun, assuming that the sun behaves as a perfect black-body radiator at a temperature of 6,000° K.

This abnormally high intensity of solar radiation occurred on February 27 and 28, 1942, when Army radar receiving equipments, working at various wavelengths in the 4–6 metre band, noticed strong directional radiations similar in character to the random fluctuations of internal receiver noise (thermal and valve noise). The radiation was first detected in the afternoon on February 26, 1942, and was almost

continuous, with some variations of intensity, between dawn and sunset on February 27 and 28, 1942. It extended over the whole receiver tuning range of about 4–6 metres. It was not observed by any site at night, and there has been no recurrence since February 28, 1942.

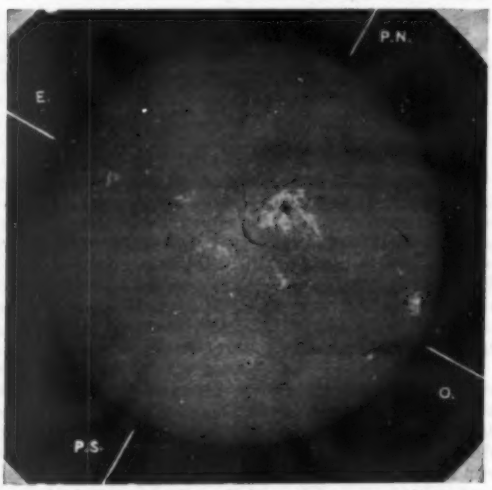
The main evidence that the disturbance was caused by electromagnetic radiations of solar origin was obtained by the bearings and elevations measured independently by the receiving sets, sited in widely separated parts of Great Britain (for example, Hull, Bristol, Southampton, Yarmouth). The operators determined the bearings according to the normal practice for finding the direction of a source of interference. It was found that the bearings moved throughout the day and were always within a few degrees of that of the sun. The most striking results came from two sites, about 150 miles apart, where the elevation was also measured. These sites were able to follow the source continuously in bearing and elevation, and observation through the equipment telescope revealed that they were looking directly at the sun.

Precise measurements of the intensity of the radiation were not made, but all reports indicate that its magnitude on the display cathode ray tubes was several times normal noise-level. From the known receiver noise and aerial characteristics, and by making an allowance for cosmic noise, it can therefore be shown that the noise-power received from the sun on this occasion was of the order of 10^{-19} watts per square metre per megacycle band-width. This unusual intensity, of the order of 10^{6} times that corresponding to the calculated black-body radiation, appears to have been associated with the occurrence of a big solar flare reported to be in a central position on February 28, 1942.

J. S. Hey.

Ministry of Supply,
London. Oct. 17.

Sir Edward Appleton's recent communication[1] and Mr. Hey's letter above on the solar radiation observed on February 26–28, 1942, suggest that the following chronicles of events may be of interest.



Spectroheliogram in $H\alpha_{2,0}$, Meudon Observatory, March 1, 1942, 0838 U.T.

On February 21 a magnificent limb eruption or flare was observed at Meudon, as the active centre shown in the accompanying spectroheliogram was crossing the east limb. During the following week, solar flares were observed from this same centre as follows:

Date	U.T.	Observatory	Intensity
Feb. 27	1052–1114	Sherborne	1
Feb. 28	0235–0257	Kodaikanal	2
	1100	Arcetri	3
	1200–1530	Sherborne, Greenwich	3
March 1	1020–1055	Zurich	2

A sudden fade-out occurred on February 28 at 1200 lasting on some circuits until 2000. On March 1 at 0727 a great magnetic storm broke out with extreme suddenness. One of the special features of this storm was a series of twenty-seven giant pulsations in H and V lasting from 1505 to 1708[2].

The radio noise reported by Mr. Hey was the earliest of the terrestrial phenomena observed, preceding the fade-out and the magnetic storm. Similar observations will be looked for with much interest.

F. J. M. Stratton.

Solar Physics Observatory,
Cambridge. Nov. 3.

[1] *Nature*, **156**, 534 (1945).
[2] *Observatory*, **64**, 263 (1942).

Rh Gene Frequencies in Britain

The genetics of the Rhesus factor have turned out to be so complex and our understanding of it has advanced so rapidly that it is difficult for many to arrive at a clear picture of the situation now substantially established. The notation has been frequently changed, and we feel that only a notation which designates unambiguously the antibodies, the genes or gene-complexes, and the antigens with which these antibodies react can avoid widespread confusion. In Table 1 we set out such a notation suggested by Fisher[1] which has been in use in this laboratory for about eighteen months. Six of the gene designations here adopted are due to Wiener[2], but for the antibodies his notation seems arbitrary. While Cappell's names[3] such as anti-C, anti-D, anti-E and anti-c are unambiguous, Wiener's do not seem satisfactory since, for example, the 85 per cent reacting serum is called anti-Rh_0, whereas besides Rh_0 it reacts with the genes Rh_1, Rh_2 and Rh_z. In the designations here used, on the contrary, Δ or anti-D indicates that the serum reacts with an elementary antigen D present equally in the gene complexes of Rh_0, Rh_1, Rh_2 and Rh_z, as shown in Table 1. (For the remainder of this communication the h will be omitted from Rh.)

The red blood cells of 927 Cambridge transfusion donors have been tested for agglutination with the four types of anti-Rh sera called Γ, Δ, H and γ in this notation. The sample was selected only in that the majority of the bloods were Group O or Group A. Tests on an unselected series of students not included in this total suggest that the distribution of the Rh groups is independent of the ABO groups.

Γ Δ H γ	Total	per cent	Most frequent genotype in group
− + + +	113	12·19	R_0r
+ + + +	126	13·59	R_1R_2
+ + − +	326	35·17	R_1r
− − − +	137	14·78	rr
+ + − −	183	19·74	R_2R_2
− − + +	12	1·29	$R''r$
− + − +	23	2·48	R_0r'
+ − − +	6	0·65	$R'r$
+ + + −	1	0·11	R_1R_0
+ − + +	0		$R'R''$
+ − − −	0		$R'R'$
+ − + −	0		$(R_0)R'$

This total of 927 does not include the first 154 persons to be tested with the four sera[4]. It is probable that the frequency of $R''r$ in this sample is by chance too high, for Stratton[5], examining a much larger sample with antisera capable of recognizing $R''r$, found only 41 out of 4,924.

The following gene frequencies are an approximate maximum likelihood solution of the data above:

R_1	CDe	43·61 per cent
r	cde	37·90 ,,
R_2	cDE	12·80 ,,
R_0	cDe	3·05 ,,
R''	cdE	1·70 ,,
R'	Cde	0·81 ,,
R_z	CDE	0·13 ,,
(R_y)	CdE	probably no more than 0·005.

Although R_1, R_2, r, etc., are conveniently spoken of as genes, they probably each represent a short strip of chromosome involving three loci, there being two alleles at each locus, C—c, D—d and E—e.

The interaction of the *Rh* genes and antibodies as they are now known are shown in the following table:

TABLE 1.

English % positive	Anti-bodies	R_1 CDe	R_2 cDE	r cde	R_0 cDe	R'' cdE	R' Cde	R_z CDE	(R_y) (CdE)
70	f	+	−	−	−	−	+	+	(+)
85	Δ	+	+	−	+	−	−	+	(−)
30	H	−	+	−	−	+	−	−	(+)
80	γ	−	+	+	+	+	−	−	(−)
65	δ	(−)	(−)	(+)	(−)	(+)	(+)	(−)	(+)
96	η	+	−	+	(+)	−	+	(−)	(−)

Fisher's theory of three linked loci[1] was based on the reactions within the enclosure[4], particularly on the antithetical reactions of the 70 and 80 per cent sera. The reactions outside the enclosure were predicted by the theory; those in brackets are yet to be confirmed serologically. Mourant[6] has found η. The description of a serum[7] giving some of the reactions predicted[8] for δ now proves to have contained an error, and it is clear that the serum being described was an example of γ, and cannot now be identified as δ.

If the elementary antigens c, d and e are separable genetically, crossing-over between them will occur, though doubtless rarely. From this point of view it is to be noted that the three common heterozygotes,

R_1r	33 per cent	
R_1R_2	11	,,
R_2r	10	,,

making together 54 per cent of the population of Britain, are all doubly heterozygous in the elementary antigens and would produce, by crossing-over, respectively,

R_0 and R',
R_0 and R_z,
R_0 and R''.

It is tempting to think that these four rarer genes in the British population are maintained by such occasional cross-overs, especially since this view would explain the fact that R_0 is nearly as common as the rarer three put together and that R_y, the only remaining combination, could not be produced by cross-overs in these common genotypes, and is in fact known to be exceedingly rare, no certain case having been discovered.

Since the frequency ratio of R'' to R_2r, representing a cross-over between d and e, is considerably larger than the ratios of R' to R_1r (cross-over c/d) and of R_z to R_1R_2 (cross-over c/e), it may be inferred that the order within the chromosome is such that c lies between d and e, or possibly that c is a small inversion or deletion. Of the heterozygotes capable, on this view, of producing R_y, only the triple heterozygotes need be considered. Of these, R_1R'' has a frequency of nearly 1·5 per cent but could only produce R_y by a double cross-over; R_2R', with a frequency 0·21 per cent, would produce it by the cross-over c/e; and rR_z, with a frequency 0·1 per cent, by the cross-over c/d. If, then, the antigenic combination R_y is not exposed to especially severe counter-selection, we should expect it to be maintained by crossing-over in the two latter cases with a frequency which may be provisionally estimated at 48 per million.

Using this estimate, we may assess the chance of discovering this eighth missing allelomorph from the frequencies of the genotypes bearing it in combinations which can now, or will later, become recognizable. Thus $R'R''$, with a frequency of about 277 per million, is serologically indistinguishable from rR_y with a frequency of about 37. Only about 1 in 8 of this rare phenotype would then contain R_y. The genotype $R''R_z$, 44 per million, is indistinguishable from R_2R_y, 12 per million. This phenotype can now be distinguished by Mourant's serum as η-negative, but in the absence of δ is still confounded with R_2R_z, about 330 per million. Finally, $R'R_z$, 21 per million, is indistinguishable from R_1R_y, 42 per million. Both absolutely and relatively, this is the most likely group in which to detect R_y, but at present it is indistinguishable from the larger δ-negative group R_1R_z. These three groups must contain more than 90 per cent of the R_y genes, and their rarity, combined with the difficulty hitherto experienced in isolating them, fully explains the fact that R_y has not yet appeared in any unequivocal case.

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Aug. 20.

[1] Race, *Nature*, **153**, 771 (1944).
[2] Wiener, *Science*, **99**, 532 (1944).
[3] Cappell, *Glasgow Med. J.*, 125 (Nov. 1944).
[4] Race, Taylor, Cappell and McFarlane, *Nature*, **153**, 52 (1944).
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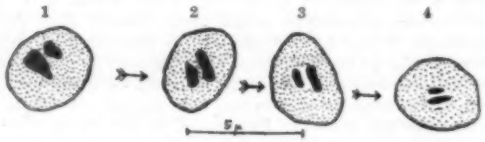
A New Mutant of *Saccharomyces cerevisiae*

UNDER favourable conditions in liquid media, *Saccharomyces cerevisiæ* divides almost every hour. Naturally, among the thousands of cells formed every day, variants ought to occur. Though variation may be discontinuous, abnormal conditions may accelerate the incidence of these variations.

Acenaphthene induces polyploidy in the particular strain (brewery yeast Sc9, N.C.T.C. 3,007) studied by us, and from active cultures in wort treated for ninety days with the above chemical a tetraploid was isolated recently[1]. Along with the tetraploid strain in wort-agar plates occurred another, which differed from it distinctly in colony characteristics. While the margins of the tetraploid colonies are translucent and the cell outlines clear, in the latter, the margins are opaque and the cell outlines indistinct. On a casual examination of the cytological preparations—made on May 29, 1945, immediately after isola-

tion—the chromosome pictures would give one the impression that these are merely the resistant controls. Closer examination, however, reveals distinct differences.

The cells vary in shape from oval to round and in size from 2·86 μ to 4·29 μ. In preparations made between 67 and 73 minutes after addition of fresh wort to a twenty-four hour culture, what seem to be the prophase chromosomes appear as two chromophile bodies of unequal size (Fig. 1). These progressively contract (Figs. 2 and 3) and give rise to the two unequal metaphase chromosomes (Fig. 4). (The figures have been drawn from Carnoy-iron-haematoxylin preparations.) Since the control has two equal chromosomes[2], it appears as if the mutant originated as a result of deletion of a portion of one of the chromosomes.



In preparations of the control, cells with unequal pairs of chromosomes have occasionally been encountered. It appears as if long treatment with acenaphthene has increased the incidence of this mutant.

The cultures of this mutant have been plated repeatedly, and the agar slants inoculated after the first isolation still show many elongated cells as seen in wort cultures undergoing treatment with acenaphthene. Unlike the control strain the cells of the mutant do not form a layer at the bottom of wort tubes, and like other deficiency heterozygotes they show comparatively poor growth.

Only future experiments would show whether this mutant is viable in the homozygous condition.

We are very grateful to Sir J. C. Ghosh and Mr. M. Sreenivasaiya for their active interest and encouragement. One of us (M. K. S.) would like to thank Messrs. K.C.P., Ltd., Vuyyur, for the award of a studentship.

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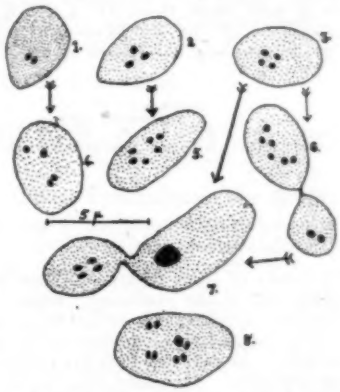
[1] Subramaniam, M. K., *Curr. Sci.*, in the press.
[2] Subramaniam, M. K., and Ranganathan, B., *Curr. Sci.*, **14**, 78 and 131 (1945).

Peculiar Cytological Behaviour of a Distillery Yeast

The question whether so-called 'pure' strains of yeast are cytologically pure ought to receive the earnest attention of those engaged in the study of the genetics of yeasts. The classification of yeasts is purely arbitrary, and the only reliable method of obtaining any particular species is to get a sample of the original culture. But even if the original culture is available one is not sure that it is cytologically pure, for proportion changes might have occurred in it since isolation. In rapidly growing organisms like the yeasts this is but natural. Investigations on higher plants indicate that polyploids usually mutate to dwarfness as a survival-measure and hence the random size relationships between the diploids and the polyploids offer no morphological criterion for differentiation into types.

It is in this connexion that the peculiar behaviour of an industrially important yeast—isolated last year by Messrs. M. R. A. N. Rao and M. Sreenivasaiya—is interesting. The strain has been kept in an active condition and before cytological investigations it was plated four times to ensure purity. Smears were made at regular intervals after addition of fresh wort to a 24-hour culture, fixed in Carnoy and stained in iron hæmatoxylin. The differentiation was rather tricky and in good preparations the cytoplasm was unstained while the chromosomes appeared lightly glistening. The meta- and ana-phase stages appear in smears made between fifty and fifty-five minutes.



In spite of repeated plating different cells in the smears show different chromosome numbers. Figs. 1, 2 and 3 show cells with two, three and four chromosomes, while Figs. 4, 5 and 8 show what may be considered as the anaphases of the diploid, triploid and the tetraploid. There appears to be 'somatic pairing' especially in the tetraploid (Figs. 3 and 7), indicating that its origin is the result of the failure of the chromosomes to separate in a vegetative division. The variations observed in the behaviour of the chromosomes of the tetraploid during budding are very interesting. In Fig. 7 is shown a mother cell with a reconstituted nucleus and the bud with four chromosomes. In Fig. 6 the mother cell has six chromosomes, while the bud has only two. Chromosome lagging in yeasts was observed by Kater[1] even in 1927. In fact, the lagging of chromosomes was cited by Tischler and Winge[2] as evidence against their being accepted as chromosomes. Needless to say, chromosome lagging has been observed by the senior author (Subramaniam[2]) in a brewery yeast (N.C.T.C. 3,007), and even in the present strain certain appearances indicate that the chromosomes may pass to the bud in pairs. This lagging of the chromosomes in the tetraploid suggests that it is genetically unbalanced and hence produces diploids and triploids with specially high frequency. Is it not possible that an unbalanced chromosome constitution could have been responsible for the peculiar behaviour of the four spores from the same ascus of the press yeast studied by Winge and Laustsen[4]?

In the distillery yeast under investigation it is probable that only mutation and segregation may produce a stable tetraploid.

We are very grateful to Sir J. C. Ghosh and Mr. M. Sreenivasaiya for their encouragement. One of us (M. K. S.) would like to thank Messrs. the K. C. P., Ltd., for the award of a studentship.

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Aug. 17.

[1] Kater, J. McA., *Biol. Bull.*, **52**, 436 (1927).
[2] Winge, Ö., *C.R. Lab. Carlsberg*, Ser. Physiol., **21**, 77 (1935).
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A Specific Effect of High-Frequency Electric Currents on Biological Objects

DURING the last four years, a systematic investigation of the effect of high-frequency electric currents on biological objects has been carried out in this Laboratory with the view of finding a specific effect apart from the heat effect hitherto generally supposed to be the only effect of high-frequency currents on tissue, bacteria, virus, etc. This view is quite natural as, with the technique hitherto used, the heat effect overwhelms any possible specific electric effect.

The frequency of the current experimented with is 20,000 kc. By means of a modulator the current is periodically turned on and off with a frequency of 10–100 kc. in such manner that the recurring current pulses are separated by current-free periods each being n times longer than the single current impulse. With the modulator employed n can be varied between 3 and 20.

Heat developed by such modulated current has a greater possibility of dissipation than heat produced by an unmodulated current. With a certain cooling of the object it is thus possible to adjust n so that the temperature of the object, through which the current passes, is kept below the temperature at which heating effects may occur. Liquids can be passed intermittently between electrodes and cooled between each passage but, as a too rapid flow makes it difficult to secure a uniform velocity of all parts of the liquid and thereby a uniform treatment, it is also in this case important to modulate the electric current. With a modulated current the actual time of treatment to be dealt with is the time only when current is passing through the object, namely, $1/n$th part of the total time of treatment.

The effect described below is due to the electric field set up by the current. The field is characterized by its maximum strength, expressed in volts per centimetre.

Bac. coli in a liquid medium were treated with the modulated current. 99·5 per cent of the bacteria were killed when the field strength was 230 volts cm.$^{-1}$ and the time used was 7 sec.; when applying 288 volts cm.$^{-1}$, the time used was 4 sec. There was no marked difference whether the treatment took place between 12° and 40° C. or 40° and 60° C. In an improved apparatus, 99·6 per cent of the bacteria were killed by 205 volts cm.$^{-1}$ in 5 sec. and 99·98 per cent with the same field in 10 sec. A similar effect produced by heat would require 60° C. in 600 sec.

Milk treated for 2·2 sec. at 340 volts cm.$^{-1}$ or for 1·3 sec. at 620 volts cm.$^{-1}$ acidified when afterwards kept at 35° C. for 18 hours in the same manner as milk previously heated to 75° C. for 30 min. The results were about the same, irrespective of whether the electric treatment took place at temperatures between 6° and 36° C. or 6° and 50° C. (If the temperature after a certain time rose from, for example, 6° to 36°, the current was cut off and the milk cooled to 6° C. before the current was again turned on.)

Foot-and-mouth disease virus was completely inactivated when treated at 260 volts cm.$^{-1}$ for 10 sec. (temperature not above 36° C.) or at 480 volts cm.$^{-1}$ for 2·4 sec. When inactivating the same virus by heat, 60 hours are required at 37° C.

A virus inactivated by heat can be used as a vaccine. The virus inactivated electrically showed no vaccinating effect. This shows that the electrical treatment acts on the virus molecule differently from the heat treatment.

Preliminary experiments with tissue cultures have demonstrated that it is possible to kill the tissue by using a modulated current without raising the temperature above 30° C. when the field strength is 22 volts cm.$^{-1}$ and the time 300 sec. When living tissue of entire organs are to be treated, the heat produced must be carried away by the circulating blood. Experiments seem to indicate that with a field of, for example, 50 volts cm.$^{-1}$, n should be below 1/200. Experiments imply, however, that it will be an arduous undertaking to produce any effect without injury to the skin and that it will be hard to attain a uniform treatment. A kind of cross-firing technique may be developed employing several electrode sets, the current being switched periodically from set to set.

A discharge couple, one in each direction, setting up a field of 5,000 volts cm.$^{-1}$ in 10^{-4} sec. has been tried. An effect similar to that of the high-frequency current is produced by several consecutive discharge couples with intervals for cooling between the discharge couples; but it has up to now been impossible to attain such uniform treatment that a result comparable to that of the high-frequency current is obtained.

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Aug. 7.

The Scientific Civil Service

THERE is one curious point about the new Scientific Civil Service which is not mentioned in the leading article of *Nature* of December 1. The men of science on whose advice the Service has been framed and those occupying important administrative positions are members of the "A" side in the Royal Society sense. So long as the requirements of the Government are confined to the "A" side, this arrangement is no doubt satisfactory; but, quite apart from medicine and agriculture, it seems probable that there will be a demand for biologists also. Biologists, however, are not likely to take kindly to having their abilities assessed by chemists or physicists, or to working under their direction. Further, biologists who have had pre-war experience of the methods of the research councils and war-time experience of the methods of Ministries still feel that the Scientific Civil Service does not yet ensure the necessary degree of professional freedom.

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RECENT GENETICAL EXPERIMENTS WITH YEASTS

By EVA R. SANSOME
University of Manchester

IN recent years geneticists have been turning more and more to the lower organisms for research material. A genetical study of the yeasts was begun some years ago at the Carlsberg Laboratory in Denmark and, more recently, by Lindegren and his collaborators in the United States and also in India. The yeasts offer certain advantages in that they are unicellular, many generations can be obtained in a short time and they can be grown under controlled environmental conditions which may be altered at will. The difficulty lies in the lack of control over sexual reproduction, but recent work indicates that this difficulty may be overcome.

Life Histories

The Saccharomycetes are normally diploid throughout the vegetative phase. The diploid condition may be brought about in several ways. Two of the four haploid spores of an ascus may fuse to form a spore zygote, or the daughter cells of two haploid spores may fuse to produce a cell zygote. In both instances the diploid so produced is heterozygous. Alternatively, a single haploid ascospore may form a number of cells by budding, which later pair to produce homozygous diploids, or a single haploid ascospore may become diploid by a nuclear division followed by nuclear fusion without cell division and fusion. This process, which Winge and Laustsen called 'direct diploidization', also leads to the formation of homozygous diploids. Haploid yeast cells can usually be distinguished from diploid ones by being relatively small and round, whereas the diploid cells are relatively large and oval[1].

The Zygosaccharomycetes are normally haploid throughout the vegetative phase, ascus formation immediately following conjugation. However, in *Zygosaccharomyces Prioranus*, the zygote may grow vegetatively, so that a culture often consists of a mixture of haploid and diploid cells. *Nadsonia Richteri* Kostka is haploid in the vegetative phase, ascus formation following a conjugation of two gametes from one mother cell. Usually only one spore is produced in the ascus.

Segregation

The assumption that meiosis occurs immediately before ascospore formation has been verified by the results obtained when individual spores are dissected from an ascus and grown separately. Winge and Laustsen[2] demonstrated that *Saccharomoycodes Ludwigii* is usually heterozygous for two factors, *Nn* for normal growth versus early inhibition of growth and *Ll* for long versus short cells. The spores normally conjugate in the ascus in such a way that the heterozygous condition is maintained. A considerable number of ascospores were isolated from *Saccharomyces cerevisiæ* and they almost all yielded distinctive cultures, indicating that this species is heterozygous for a number of factors. About 50 per cent of the ascospores failed to grow after germination[3]. The Lindegrens also obtained segregation of different types in *S. cerevisiæ* indicating extreme heterozygosity[4]. Lindegren claims that there is one pair of factors controlling mating type in *S. cerevisiæ*, haploids of opposite mating type tending to pair more readily than haploids of the same mating type. When fifty-eight single ascospore cultures derived from a variety of industrial bakers' yeasts were intercrossed, they could be classified into two groups as regards mating type. Occasionally lines of the same mating type will conjugate, and, as described by Winge, cells within a single haploid clone will mate. The conjugation of two cells of like mating type has been called 'illegitimate' mating by Lindegren and, according to him, usually leads to poor sporulation. The round-celled haplophase cultures often become stabilized in the haploid condition and lose their power of mating after being maintained in the haploid condition for some time[5]. The Lindegrens report a 2 : 2 segregation of the mating type factors. Similarly, segregation of factors controlling the fermentation of melibiose has been shown in hybrids between *S. cerevisiæ* and *S. carlbergensis*. A 2 : 2 segregation for cell shape was observed in the ascus of *S. italicus*[6].

S. unisporus is characterized by producing only one spore in the ascus. The spore germinates to produce a diploid colony as evidenced by the shape of the cells and the capacity to produce asci without further conjugation. Winge believes that 'direct diploidization', resulting in the formation of a homozygous diploid, occurs. However, it seems that there is also a possibility that two haploid nuclei may fuse to produce a diploid spore nucleus. This would result in a heterozygous diploid. Sixteen spore isolates from a culture originating from a single cell all showed differences from the original type and each other, whereas six single-cell cultures were identical with the original type[3]. This indicates segregation in the formation of the ascospore, but it is not possible to tell whether this is due to segregation of factors from an originally heterozygous diploid or whether it is due to the segregating out, in the homozygous condition, of mutants that have occurred in an originally homozygous diploid.

Cytoplasmic Effects

Winge and Laustsen give evidence of an effect attributable to cytoplasm in *S. cerevisiæ*[1]. They found homozygous diploids produced by 'direct diploidization' to differ from homozygous diploids of identical nuclear constitution formed by cell fusion. The cells appear to be smaller and less vigorous; and whereas about 30 per cent of the ascospores obtained from diploids resulting from cell fusion germinated, only about 0·6 per cent of those from diploids originating by 'direct diploidization' germinated. The authors explain these results by assuming that the chondriosomes are self-perpetuating and divide later than the nucleus. Thus, in the case of 'direct diploidization' the resulting diploid has only half the usual number of chondriosomes—a deficiency that is irreparable. The fact that in *S. validus* diploids produced by 'direct diploidization' are vigorous and give a high percentage of ascospore germination is explained by assuming that the chondriosomes divide more nearly at the same time as the nucleus in this species. Whether the authors' explanation proves to be correct or not, they have undoubtedly shown an effect of the cytoplasm on inheritance.

An interesting relationship between gene, cytoplasm and substrate has been demonstrated in the production of certain specific enzymes[4]. *S. carlbergensis* can adapt itself to melibiose fermentation, whereas *S. cerevisiæ* cannot. By mating a haploid clone known to contain a single gene for adaptability from *S. carl-*

bergensis with an *S. cerevisiæ* haploid a hybrid was obtained which could ferment melibiose. When the four ascospores from an ascus of the hybrid were isolated in the absence of melibiose and afterwards tested they were found to segregate in a 2 : 2 ratio for the capacity of adaptation to melibiose fermentation. When, however, melibiose is present throughout the isolation process, all four ascospore cultures are able to ferment melibiose. Similar results were obtained for the capacity of adaptation to galactose from crosses involving *S. cerevisiæ*, adaptable to galactose fermentation and *S. Bayanus*, non-adaptable. It seems that both the gene controlling a specific enzyme and the substrate are necessary for the induction of the enzyme. Once present, however, the enzyme can be perpetuated in the cytoplasm without genic action if the substrate is present.

Mutation

Mutation has been studied in some detail in the haploid, *Nadsonia Richteri*, by Skovsted[7]. Mutants differ from the original type and from each other in size and shape of cell, extent of sporulation and details of ascospore formation and in the size, colour and form of their giant colonies on lager-wort gelatine. The mutants all produce asci on lager-wort gelatine although the original type did not. Mutants were picked out as sectors reaching the edge in giant colonies. Single-cell cultures from the original culture were of two types. One culture of the predominant type was chosen for further study. A number of single-cell cultures of this type each gave the same two types of mutants. Each of these types produced three new types. Of these six types, two were tested and each gave four new types. Five of these eight types gave altogether twenty-three new types. Thus, although only two mutant types could be obtained from the original type, further types could be obtained from these mutants and their derivatives. Skovsted has described this process as 'successive mutation'.

In the case of *Saccharomyces*, mutation has to be distinguished from segregation. Winge[2] found that mutations occurred in old cultures derived from single ascospores and therefore originally homozygous. Spiegelman and Lindegren[8] have given evidence of the genetical variability of haploid strains of *S. cerevisiæ*. 'Illegitimate' diploids, on the other hand, are very stable when kept under conditions which prevent sporulation. When these diploids are allowed to sporulate, however, segregation often takes place, indicating the occurrence of mutation which had been hidden in the diploid because of the presence of the normal allele.

There are three main circumstances affecting the detection of a mutant: (1) the frequency of occurrence, (2) the possibility of expression, and (3) the survival of the mutant in competition with the parental type. In the case of the haploid *Nadsonia*, the possibility of expression of a mutant character is very great in contrast to the diploid *Saccharomyces*, where the presence of a normal allele at the corresponding locus will usually suppress the expression of a new mutation until segregation occurs at sporulation. However, the survival factor must operate very powerfully in the case of mutants appearing in giant colonies, and only mutants with a growth-rate equal to, or surpassing, that of the normal can be expected to survive and give sectors reaching the edge of the colony. In the case of *Saccharomyces*, weak mutants are protected from the effects of competition by the presence of their normal alleles and only appear when ascospore formation occurs. When fusion follows rapidly on ascospore formation, such types may be carried in the heterozygous condition through succeeding sexual generations. Evidence that such weak types occur in *S. cerevisiæ* was given by Winge, who found that although the percentage of germinating ascospores was high, about 50 per cent of the cultures stopped growing soon after germination[2].

The phenomenon of successive mutation as observed in *Nadsonia* may be due to three causes. The original type may be capable of throwing a number of different mutations, only two of which can compete with the parental type in the conditions of the experiment, but in the genetical environment of the new types some of the other new types may become able to compete. Secondly, the new types may permit the expression of genes which are unable to express themselves in the original type. Thirdly, the new types may lead to the actual occurrence of different mutations.

These studies are of great interest to the geneticist since they afford information regarding the occurrence of mutation and the nature of gene action. They should be of interest to the mycologist because they clarify and enhance our knowledge of the life-histories of these lower forms.

[1] Winge, Ö., and Laustsen, O., *C.R. Lab.* Carlsberg, Série Physiologique, **23**, 17 (1940).
[2] Winge, Ö., and Laustsen, O., *C.R. Lab.* Carlsberg, Série Physiologique, **22**, 99 (1937).
[3] Winge, Ö., *C.R. Lab.* Carlsberg, Série Physiologique, **24**, 79 (1944).
[4] Lindegren, Carl C., *Ann. Missouri Bot. Garden*, **32**, 107 (1945).
[5] Lindegren, Carl C., and Lindegren, G., *Ann. Missouri Bot. Garden*, **31**, 203 (1944).
[6] Ditlevsen, E., *C.R. Lab.* Carlsberg, Série Physiologique, **24**, 31 (1944).
[7] Skovsted, A., *C.R. Lab.* Carlsberg, Série Physiologique, **23**, 409 (1943).
[8] Spiegelman, S., and Lindegren, C. C., *J. Bact.*, **49**, 257 (1945).

RESTORATION OF SCIENCE IN AUSTRIA

IT was the aim of a meeting called on November 3, by the Association of Austrian Chemists, Engineers and Scientific Workers in Great Britain, to enlist support from British men of science for the restoration of a genuine scientific life (physics, chemistry, biology) in free Austria. In a leaflet distributed*, the extent to which science in Austria has suffered under seven years of Nazi domination is described. The advance of Fascism all over Central Europe made itself felt in Austria's scientific life even before the annexation; but German rule and the War brought large-scale destruction. Many buildings, including the University Library in Vienna and Prof. Hans Przibram's Vivarium, have been heavily damaged, and repair work is most difficult at the present level of industrial activity. Even more serious is the intellectual and moral damage.

A large number of Austria's leading men of science have been banished by the Germans, or prevented from returning there had they wished to do so. The names alone of the men of science who have combined to promote the meeting (all of them outside Austria) make impressive reading. They include the mathematicians, K. Menger and R. von Mises; the physicists, V. F. Hess, Lise Meitner, K. Przibram, E. Schrödinger and K. Weissenberg; the chemists, E.

* Obtainable from the Hon. Secretary, 133 Hatherley Court, London, W.2.

Abel, F. Feigl, P. Gross, H. von Halban, sen., H. Mark, F. A. Paneth and W. Pauli, sen.; the biochemists and biologists, F. Bergel, S. Jellinek, O. Loewi and L. Portheim. Others, like Hans Przibram, have died in concentration camps. Finally, Austria has been isolated from the democratic world and starved of literature other than Axis literature. So it may truly be said that the reconstruction of the Austrian universities will be a Herculean task.

It is gratifying to know that the first condition for the fulfilment of the task is being met by a purge of the schools of Nazis, carried out by the Provisional Government of the Republic. At the same time, instruction is reformed; for example, the teaching of languages—English and the Slav languages—is being extended, and para-military training has been abolished. Another encouraging feature is the energy with which the students are tackling the task of rebuilding the laboratories with their own hands.

Sir D'Arcy W. Thompson, the chairman of the meeting, recalled that some sixty years ago, a few years before the discovery of the X-rays and of radioactivity, and before the development of quantum theory and the theory of relativity, it seemed to many that not much was left to be done in science. Sir D'Arcy forecast similar revolutions, and expressed his confidence that Austria, like other countries, would contribute to them. Among Austrian men of science of the past he singled out L. Boltzmann, who inaugurated a new era in physics, and is of particular interest to British men of science because of his association with Maxwell in more than one field. Prof. F. G. Donnan was hopeful that British, American and Soviet men of science will extend a helping hand. Among Austrian scientific workers he named specifically the older physicists, Doppler, Stefan, Loschmidt, Mach and, above all, Boltzmann; the contemporary physicists, Stefan Meyer, K. Przibram, Schrödinger, Lise Meitner, Pauli; the chemists, Wegscheider, Abel, Paneth, Mark, K. H. Meyer, and the pioneers of micro-chemistry, Pregl, Emich and Feigl; the father of genetics, Mendel; the founder of psychoanalysis, Freud.

Prof. L. Hogben dealt particularly with the devastating influence of pseudo-scientific racialism and said: "It is high time for someone to say, and to scy on the housetops, that the moral horrors of the Belsen camp are the practical application, with a ruthlessness particularly Prussian, of a body of views, some of which are scientifically false, some entirely unproved, at best distortions of established truth impudently masquerading with the guise of biological science. I believe them to be false for reasons I set out as a professional biologist in my book 'Nature and Nurture' which appeared significantly before Hitler's rise to power. . . . I say significantly because such views are not confined to Nazi circles. They did not originate exclusively in Germany, though they there fell on receptive soil. They do not automatically die with the death of the Nazi regime. . . . Because these views are still widely prevalent, because they are still a septic focus in the body politic, it is still necessary to refute them publicly wherever and whenever they find exponents. That is one of my reasons for participating in this gathering, not to emphasize what British science can do for Austria, but to suggest what the rebirth of Austrian science can contribute to a saner British outlook on man's social relations. For those who are rebuilding Austrian science have reason to recognize the malign consequences which *Rassenhygiene* or Eugenics, call it what you will, have left in their train; and I do not believe that you will lightly tolerate attempts to rehabilitate in the cap and gown of academic respectability an ideology which has brought untold misery to your country. . . . During the past ten years there has been a Central European black-out of publications contributory to the advancement of intellectual freedom and civic enlightenment. . . . Might it not be at least a helpful gesture if a group of British scientific men who have played their part on the ideological front against the Nazi conspiracy against human freedom offered to make a first edition of their writings available for publication in Austria without monetary recompense as royalties? I do not think that our American colleagues would be slow to co-operate if we signified our will to do so."

Prof. P. M. S. Blackett, the last of the British speakers, paid tribute to Hess, who laid the basis of cosmic ray research, and expressed his pride in having had O. R. Frisch in his laboratory. He welcomed the idea of organizational union of academic and industrial men of science, as achieved in the Association of Austrian Chemists, Engineers and Scientific Workers in Great Britain and in the (British) Association of Scientific Workers. He stressed the necessity of equipping laboratories with up-to-date research tools, many of which are expensive; in the liberated countries this will often be possible only with collaboration from outside. Blackett specially supported plans for the exchange of personnel. Finally, Prof. K. Przibram, of the Radium Institute of the Vienna Academy of Sciences, who lived in Belgium during the German occupation, described the moral effects on men of science of intellectual isolation, and expressed Austria's desire to break this isolation as soon as possible.

At the end of the meeting it was announced that a committee of British men of science is being formed to implement suggestions for practical help. In particular, the committee will at the present stage concentrate on the question of the supply of literature.

E. Broda.

HÆMOGLOBIN LEVELS IN BRITAIN

THE Report of the Medical Research Council's Committee on Hæmoglobin Surveys*, entitled "Hæmoglobin Levels in Great Britain in 1943 (with Observations upon Serum Protein Levels)", is a valuable record of one aspect of national war-time health. The hæmoglobin level of some thirteen thousand adults (including seven hundred pregnant women) and some three thousand children were measured from the middle of the spring of 1943 until the middle of the autumn of that year. The Haldane–Gowers method was used and its efficacy is discussed. Although the Committee does not consider this method ideal, it concludes that it was accurate enough to justify the broad conclusions which are recorded in the 128 pages of this report, which is well illustrated by diagrams and graphs. The technical evidence thus published cannot be summarized adequately here. The main conclusions, very briefly given, are as follows.

Severe grades of anæmia were rarely observed. Among men there was little difference, if any, between the hæmoglobin level of married and single men. In the age groups 20–49 both showed a virtually

* Special Report Series, No. 252 (H.M. Stationery Office, 1945). 2s.

unchanging level (single men 103·2 per cent; married men 102·5 per cent), with a slight fall at ages over 50. The mean level for men (102 per cent) was only a little below the mean level which was regarded as satisfactory before the War. In women, on the contrary, the mean level for both single and married women fell slightly during the later part of the age period 20–49 years, but rose again after 50 years of age. This fall and rise may be associated with menstruation and its cessation. The figures for married women up to the age of 60 were, however, roughly 2 per cent below those for single women. There was evidence which suggested that this difference may have been associated with child-bearing; the figures for women without children did not differ appreciably from those for single women. The average values for women were, moreover, considerably below those for men. At and above 60 years the fall for men and the rise for women made the curves converge. At every age below the menopause there was a small but consistent decline in the average hæmoglobin level as the number of pregnancies increased. This may have been directly due to parturition or indirectly to poorer nutrition of the mother as the family increases. As the *Lancet* (310, Sept. 8) says, women with families were not getting enough blood-forming foods and the children's ration was inadequate, so that the mother and father made it up with some of their rations. Serious anæmia in women was not, however, common. The report considers in some detail the relation between the hæmoglobin levels and the bearing of children.

Among young children of 2–5 years the incidence of anæmia was found to be unduly high; but we have little information about the hæmoglobin level of normal children. In general, the hæmoglobin levels of children rose from 1 to 7 years, altered little up to 10–11 years and then steadily rose to a maximum in boys of 16–19 years. In girls at the same ages the levels were 5–6 per cent lower. But both boys and girls had higher values than 'adults' under 20 years not at school, perhaps because the school children who belong to the higher income groups are better fed.

Discussing the relation of hæmoglobin levels to occupations, the Committee found that these levels were high for men in the Civil Services, police (mostly Scotland Yard) and among students and male laboratory workers. Among women, they were high in the Civil Service and W.A.A.F. (mostly new entrants); they were lowest among textile workers and also low among nurses. The hæmoglobin levels of 990 Canadian soldiers serving in Great Britain showed a mean level 5 per cent higher than that of a comparable age group of British adult male civilians (excepting the medically selected Scotland Yard officials and the higher grades of the Civil Service).

The major causes of the low hæmoglobin levels in a group of adults studied was found to be iron deficiency, and the low level was removed by iron therapy.

On the whole, the hæmoglobin levels found were higher than those obtained in Aberdeen in 1935, but the Aberdeen subjects were unemployed or belonged to the lowest income groups. It is known that hæmoglobin levels vary with family income. Foods containing iron and other hæmopoietic substances, excepting cereals, are in the more expensive categories. The economic status of the present survey was higher than that of the Aberdeen studies, and no unemployed were included. An appreciable incidence of subnormal levels was, however, found; and the evidence suggested that these were due to a dietary deficiency, especially of iron. National flour has added 2 mgm. of iron per head per day to the diet of the working class and some 3 mgm. per head per day to schoolboy diet (adolescent schoolboys being among the largest eaters of national flour). At no time has the total amount of iron per head per day been less than Sherman's most recent figure of normal requirements. Discussing the influence upon hæmoglobin levels of national flour, the Committee notes that protein and vitamin C are also needed for hæmoglobin synthesis. There has been an increase of animal protein purchased from 29·3 gm. per head per day in 1941 to 33·2 gm. per head per day in 1943 and a slight increase in ascorbic acid. These increases may have helped to improve hæmoglobin levels. Bread is the main single source of iron for all classes except infants, but national flour contains more phytic acid than white bread and this renders iron less easily absorbable. On the other hand, increased phytic acid is accompanied by increase of phytase, so that the phytic acid increase may not be so deleterious as it seems to be.

Summing up, the Committee concludes that the hæmoglobin levels found during the four years of the War surveyed were reasonably good. We need, however, to raise the levels of certain groups, especially those of young children, pregnant women and people at the lower economic levels. Future surveys should employ standardized methods (which are discussed), personnel who are as free as possible from personal errors, and large enough groups; they should study the social background and food intake of the groups selected and also any other factors which influence the hæmoglobin levels.

G. LAPAGE.

FORTHCOMING EVENTS

Saturday, January 12

ASSOCIATION OF BRITISH ZOOLOGISTS (at the Zoological Society of London, Regent's Park, London, N.W.8), at 10 a.m.—Eleventh Annual Meeting.

INSTITUTION OF MECHANICAL ENGINEERS, GRADUATES' SECTION (at Storey's Gate, St. James's Park, London, S.W.1), at 3.30 p.m.—Mr. S. Sarwal: "Fuel Injection System on Diesel Engines".

Monday, January 14

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Country Road Lighting" (to be opened by Mr. C. R. Bicknell).

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Austrian Centre, 69 Greencroft Gardens, London, N.W.6), at 7.15 p.m.—Dr. F. Singer: "Modern Ceramics".

Tuesday, January 15

ROYAL SOCIETY OF ARTS, DOMINIONS AND COLONIES SECTION (joint meeting with the INDIA AND BURMA SECTION, at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. Heaton Nicholls: "The Indians of South Africa".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. Eliot T. Slater: "An Investigation into Assortative Mating"; Mrs. Moya Woodside: "Courtship and Mating in an Urban Community".

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (in the Reynolds Hall, College of Technology, Manchester), at 5.30 p.m.—Dr. B. Ifor Evans: "The Relationship of the Arts".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5.30 p.m.—Dr. Leopold Stein: "Notes on the Natural History of Speech".

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Prince's Gate, London, S.W.7), at 6 p.m.—Mr. E. W. H. Selwyn: "How it Works in Photography", No. 3: "Grain and Resolution".

Wednesday, January 16

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Jack Drummond, F.R.S.: "Famine Conditions and Mal-Nutrition in Europe".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Scientific Papers.

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. C. F. Booth and Mr. F. J. M. Laver: "A Standard of Frequency and its Applications".

ROYAL INSTITUTE OF CHEMISTRY, LONDON SECTION (joint meeting with the LONDON SECTIONS of the BRITISH ASSOCIATION OF CHEMISTS and the ASSOCIATION OF SCIENTIFIC WORKERS, at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6.30 p.m.—Discussion on "The Present and Future Roles of the Technical Press".

SOCIETY OF CHEMICAL INDUSTRY, FOOD GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Discussion on "Science and Tea" (Dr. L. H. Lampitt: "An Historical Survey"; Dr. A. E. Bradfield: "Recent Developments in the Chemistry of Tea").

Thursday, January 17

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. H. M. MacNeille: "Partially-ordered Sets".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. E. D. Hughes: "Substitution" (Tilden Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. A. G. Ellis: "Some Notes on Transformer Practice with reference to Standardization".

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Manson House, 26 Portland Place, London, W.1), at 8 p.m.—Dr. Edward R. Cullinan: "Medical Disorders in East Africa".

Friday, January 18

INSTITUTION OF MECHANICAL ENGINEERS, in association with the STEAM GROUP (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. G. A. Plummer: "The Development of the La Mont Boiler in Great Britain"; Mr. G. A. J. Begg, Mr. W. M. Hebblethwaite and Mr. G. Cooke: "Operating Experience with La Mont Boilers with special reference to Feed Water Problems".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

CHIEF ENGINEERING ASSISTANT IN THE ENGINEER AND SURVEYOR'S DEPARTMENT—The Clerk to the Esher Urban District Council, Council Offices, Esher, Surrey, endorsed 'Chief Engineering Assistant' (January 18).

SENIOR IRRIGATION ENGINEERS for the Directorate-General of Irrigation, Iraq—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting E.1817.A (January 18).

LECTURER (full-time) IN MECHANICAL ENGINEERING at the Municipal Technical College—The Director of Education, Education Offices, Guildhall, Kingston-upon-Hull (January 18).

GRADUATE LECTURER (temporary) IN BIOLOGY, with qualifications in Anatomy and Physiology, at the Crumlin Mining and Technical College—The Director of Education, Further Education Department, County Hall, Newport, Mon. (January 20).

LECTURER IN ELECTRICAL ENGINEERING at the County Technical College—The Director of Education, County Education Offices, Stafford (January 21).

ENGINEERING ASSISTANT to survey and prepare an irrigation scheme for 24,000 acres; alternatively, an EXPERIENCED SURVEYOR to carry out the survey in connexion with the irrigation scheme—The Clerk, Rother and Jury's Gut Catchment Board, Watch-Bell Chambers, Watch-Bell Street, Rye, Sussex (January 21).

LECTURERS (2, permanent; 1, temporary) IN PURE MATHEMATICS in the University of Cape Town—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting A.1215.A (January 22).

LECTURER IN CIVIL AND MECHANICAL ENGINEERING—The Principal, West Ham Municipal College, Romford Road, Stratford, London, E.15 (January 22).

RESEARCH CHEMIST to superintend manufacture and improvement of photogravure inks—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting F.4915.XA (January 22).

ASSISTANT RESIDENT CHEMIST AND BACTERIOLOGIST with experience in the examination of water and some knowledge of freshwater microbiology—The South Essex Waterworks Company, Hornchurch Road, Romford, endorsed 'Assistant Chemist' (January 23).

DISTRICT ENGINEER for service with the Sudan Railways on maintenance and construction of permanent way, bridges and buildings—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting E.2197.A (January 25).

ASSISTANT MASTER to take CHEMISTRY and PHYSICS—The Principal, Enfield Technical College, Queensway, Enfield, Middx. (January 26).

LECTURER IN THE MINING DEPARTMENT—The Principal, Technical College, Church Street, Barnsley (January 26).

ASSISTANT ENGINEER in the Water Department—The Town Clerk, Council Offices, North Street, Chichester, endorsed 'Appointment of Assistant Engineer' (January 26).

CHIEF ASSISTANT ENGINEER—The Borough Electrical Engineer, Lime Tree Place, Mansfield (January 26).

CHEMIST or PHYSICAL CHEMIST by Petroleum Research Laboratory near London, for research on combustion in internal combustion engines and jet propulsion units—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting F.5401.XA (January 26).

CIVIL ENGINEERS by the Air Ministry for various overseas Commands—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting E.2257.A (January 29).

SENIOR SCIENTIFIC OFFICER (Engineer) with knowledge of design and maintenance of engineering plant (Ref. No. C.3012.XA), a PLANT ENGINEER preferably with experience of iron and steel industry and knowledge of structural, mechanical and electrical engineering (Ref. No. C.3013.XA), SCIENTISTS for operational research on problems (for example, logistical problems) of the iron and steel industry (Ref. No. A.1045.XA), a METALLURGIST with knowledge of blast-furnace operation (Ref. No. F.5414.XA), METALLURGISTS, CHEMISTS, PHYSICISTS and ENGINEERS, mostly in the grade of Scientific Officer (Ref. Nos. F.5415.X, F.5416.X), a SCIENCE GRADUATE (preferably a woman) for technical information and library work (Ref. No. F.5417.XA) for the British Iron and Steel Research Association—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting B.I.S.R.A. and appropriate Ref. No. (January 30).

ARCHÆOLOGIST (full-time, man or woman)—The Keeper of the Museum, Yorkshire Museum, York (January 31).

DEPUTY CLERK OF THE COURT—The Principal, University of London, Senate House, London, W.C.1, endorsed 'Court' (January 31).

ASSISTANT WATER ENGINEER—The Managing Director, Lowestoft Water and Gas Co., 165 High Street, Lowestoft (January 31).

PRINCIPAL of the Scunthorpe Technical High School and Technical School—The Director of Education, County Offices, Lincoln (January 31).

LECTURERS (3) in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING—The Registrar, University College, Southampton (February 1).

SENIOR RESEARCH OFFICER for X-Ray Crystallographic investigations of a fundamental nature with the Chemical Physics Section of the Division of Industrial Chemistry, Council for Scientific and Industrial Research—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (February 8).

LECTURER IN PHYSICS at the Royal Aircraft Establishment Technical College, Farnborough, Hants—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting C.3030.A (February 9).

READERSHIP IN PHARMACOLOGY tenable at Guy's Hospital Medical School—The Academic Registrar, University of London, Senate House, London, W.C.1 (February 12).

ASSISTANT LECTURER IN PHYSICS—The Registrar, The University, Sheffield (February 16).

LECTURER IN, and HEAD OF THE DEPARTMENT OF, PHILOSOPHY at University College, Dundee—The Secretary, The University, St. Andrews (February 22).

DEPUTY LIBRARIAN (male)—The Registrar, The University, Leeds 2 (March 20).

LECTURER IN PHYSICS, with special qualifications in Medical Physics—The Secretary, The University, Aberdeen (March 30).

PROFESSOR OF SURGERY—The Registrar, The University, Manchester (April 20).

SENIOR MECHANICAL ENGINEERS (2) (Ref. No. C.3020.A), and MECHANICAL ENGINEERS (2) (Ref. No. C.3021.A), by the Sudan Government, for service on the installation and maintenance of the various mechanical engineering projects of the Department of Agriculture and Forests—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No.

TECHNICIAN for the ANATOMY DEPARTMENT—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, London, W.C.1.

LECTURER IN PHYSIOLOGY, and a DEMONSTRATOR IN PHYSIOLOGY—The Dean of the Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1.

RADIUM CUSTODIAN (non-resident)—The Secretary, Mount Vernon Hospital and the Radium Institute, Northwood, Middx.

TECHNICAL ASSISTANT FOR BIOCHEMICAL LABORATORY of the Chester Beatty Research Institute—The Secretary, Royal Cancer Hospital (Free), Fulham Road, London, S.W.3.

SKILLED LABORATORY ASSISTANT IN THE CHEMISTRY DEPARTMENT—The Steward, Department of Chemistry, The University, Manchester.

OFFICER-IN-CHARGE of work in the preparation of patents specifications, and a DEPUTY HEAD of the Library and Information Bureau—The Director, Shirley Institute, Didsbury, Manchester.

GRADUATE (or equivalent) IN ENGINEERING for work in Ordinary and Higher National Certificate Courses in Mechanical Engineering; alternatively, a GRADUATE IN PHYSICS OR MATHEMATICS with Engineering qualifications—The Principal, Technical College, Kendrick Hall, Stroud, Glos.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Catalogues

Periodicals and Newspapers relating to the Theatre, Literature, Art, Science and Politics. (Catalogue 76.) Pp. 28. (London: Ifan Kyrle Fletcher, 12 Lansdowne Road, S.W.20, 1945.)

Sunvic Electronic Relay, Type E.A.2. (Publication EA.10a.) Pp. 2. (London: Sunvic Controls, Ltd., 1945.)

Marfanil (para-Aminomethyl-benzene-sulphonamide-hydrochloride). Pp. 4. (Barking: R. F. Reed, Ltd., 1945.)

Catalogue du fonds. Pp. 32. Prix courant du Catalogue de fonds. Pp. 4. (Paris: Libr. Paul Lechevalier, 1945.)

Early Printed Books: Incunabula, Woodcut Books, Humanist Learning, Early Arabic and Hebrew Texts, Early Photography. (Catalogue 7.) Pp. 40. (London: E. Weil, 28 Litchfield Way, N.W.11, 1945.)